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Forthcoming Events.

SEPTEMBER 5.

Institution of British Foundrymen (Lancashire Branch):—Visit to Messrs. R. & J. Dempster's Works at Manchester.

SEPTEMBER 9-11.

Iron and Steel Institute:—Autumn meeting at Birmingham.

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

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Scottish: J. Bell, 60, St. Enoch Square, Glasgow.
London: H. G. Sommerfield, Charterhouse Chambers, Charterhouse Square, London, E.C.1.
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Secretary: F. J. Griffiths, 20, Fisher Street, Swansea.

Foundry Trades Equipment & Supplies Association.

Secretary: K. S. Bridges, Avenue Chambers, Southampton Row, London, W.C.1.

Cast Iron Houses.

In the evolution of civil and mechanical engineering, it has been customary and commercially economic to replace wood, stone, and brick by cast iron when only static stresses had to be met. Later, especially where heavy transverse stresses had to be overcome, there was a tendency to replace cast iron by steel. It should be a *sine qua non*, that for constructional purposes there should be taken into consideration the following factors:—Strength for bulk; durability; speed of assembly, and cost. We have noted, with some dismay, the great amount of publicity given to steel as a material for house construction, and similarly objections raised by laymen to the use of cast iron. More than one influential daily has objected to the use of cast iron on the grounds of excessive corrosion as compared with steel. The original cast-iron water pipes laid down for the waterworks at Versailles, about 200 years ago, are still in use, which we doubt would be the case if steel had been employed. Why the statement that cast iron is more subject to the ill-effects of corrosion than steel should have gained currency it is difficult to realise. After conversations with a number of engineers, we feel more than satisfied that on making a serious attempt to correlate the four factors specified, east iron compares more than favourably with normal house-construction materials than steel.

Such work could be undertaken in the foundries which are most affected by the present industrial slump—those normally engaged upon marine engineering, agricultural implements, furnace castings, large mechanical engineering and jobbing shops.

We were recently assured by the Provost of Falkirk, that ever since the armistice, the foundries of his town had been fully employed, and *light castings, mainly for house construction, is its staple industry.* This is also true of all the other light castings' foundries throughout the kingdom. If gutters, fall pipes, ranges and similar work can keep such an important section of the foundry industry fully employed, it becomes easy to visualise the marked effect there would be upon the industry, if cast-iron houses could receive the recognition they deserve. We do not insist that cast iron should exclude to the utmost limit every other constructional material. In every engineering construction, no engineer, unless he has a "bee in his bonnet," confines himself to one metal or alloy. So, too, we feel the ultimate design for the rapid and economical construction of dwelling houses, having regard always to durability, will be a complex structure incorporating both cast iron and steel, exactly as is found in most engineering construction. We ask our readers to make propaganda whenever and wherever they can for the utilisation of cast iron as prime material for house construction. The firms supplying raw materials and plant to foundries also have interest in aiding this movement. We deplore the non-existence of a national commercial association of foundrymen who could speak on such subjects as a representative body.

The Selling of Castings.—XVII

By Voyageur.

Many founders do not take sufficiently seriously the question of catalogues of their products. Either they do not issue any, or they hand a batch of ill-written matter, consisting mostly of superlatives, to the nearest (and often cheapest) printer, leaving him to do all the work of arrangement. As a result, one sees only too often a jumble of assorted and ugly types, much overemphasis, sometimes illiteracy, and seldom a catalogue that really sells. It is true that there are printers who take a pride in their work, and do their best to make a good catalogue out of the material submitted to them: but even so, only the founder himself knows his own business sufficiently well to present it in the way most attractive to buyers. Catalogues designed by printers, too, often smack of the advertising department, which is fatal.

The question of whose uses and needs the catalogue has a great influence upon its policy and design. Thus, if the purchasing of castings is entrusted to a works manager or foreman, a different style will have to be adopted in catalogues sent to him from that necessary when a centralised purchasing department is responsible for purchases. Generally the former method is found in small establishments, the latter in larger and better organised works. This is why modern selling-practice tends to differentiate sharply between the catalogue and sales booklet. The catalogue is designed chiefly for the large buying department, the booklet for the works manager or foreman.

Catalogues of castings should comprise help for the buyer in his work of purchasing material (*e.g.*, shrinkage figures) that will increase the value for him of the catalogue as a work to be referred to, and every argument that will induce him to place his orders with the publisher of the catalogue. One large steel founder issues a catalogue of forty pages, that is, from first to last, replete with facts about steel castings that the buyer ought to know. It has chapters on the heat-treatment of steel castings; their permeability, in the case of dynamo-magnet steel castings; how they should be ordered; how they are packed; how they are cleaned, and the importance of this cleaning; the advantages of different steels for different kinds of castings; the importance of production facilities to the user; and so forth. Any buyer who needed steel castings would find it perfectly simple, even if he knew no more about castings than that someone in the works wanted them, to send out an inquiry or an order with the knowledge that he would get suitable material supplied or quoted for.

It stands to reason that a catalogue of this sort is valuable to buyers. It is unusual, and therefore noticeable. It has a dignity and efficiency that a mere price-list or "puff" could not have. There is so much material in it of service that buyers feel bound to preserve it. And as long as it is preserved it is helping to sell the goods it discusses.

The trouble with many founders is that they believe their customers to know as much about their goods as they do themselves. They imagine that a plentiful supply of pictures illustrating the class of work they do or have done is sufficient to tempt the customer to give them a trial. It is not. Here, as everywhere else, in selling castings, argument must replace mere assertion. The buyer must be told *why* your castings are worth having.

In the matter of design, casting-catalogues are often very poor. It is incorrect to suppose that capital letters are more legible than small ones. They have been finally and definitely proved less so, and should not be used more than can be helped.

The text should be written out first, in full: and the arrangement should not be begun until all corrections and alterations have been made to the wording. Next, the illustrations should be selected. Much retouching work can be saved by closer attention to the work of photographing any castings chosen for illustration. A little French chalk rubbed along the edges will bring them up sharply in the ensuing print. Rough castings should have as little retouching work as possible expended on photographic reproductions of them. They lose reality otherwise.

A good idea is to enclose with the catalogue a trial order form, enabling the customer to order conveniently a sample lot of castings, assuming the arguments put forward for his consumption have been effective.

The cost of the catalogue should depend largely upon the amount of profit yielded by the castings, and by their size and selling-price. For example, small aluminium castings do not need so large a book as big steel castings of sixteen tons in weight or more. Overcrowding of pages should be avoided. As far as possible, there should be only one illustration to each page. Two or more on a single page tend to detract from each other. Each illustration should have a "cut-line" or line of description under it, so that even though the pages are only glanced through, the pictures will tell something of the story.

Separate subjects should be kept as far as possible to separate pages. The question of using a second colour for ornamental purposes, or in order to stress particular points, needs careful thought. If it is decided to employ red or another colour in addition to the black of the text, use of it should be sparing. Nothing is more unsightly and unpleasing than a catalogue which looks as if someone had cut his throat over it, owing to the vulgar way in which red is splashed here, there and everywhere. As a matter of fact, red is too common and dazzling a colour for casting-catalogues. Dark green, dark blue, or brown, are much better colours. But the text of the catalogue should always be in black, for the simple reason that black is more legible than any other ink.

Plenty of white space should be left at the margins. Corners should always be square, not rounded. They look more dignified and business-like so. The cover should be dignified, not gaudy. As a rule a plain type title, tastefully set and arranged, is better than a pictorial design, only too often executed in three or four glaring colours. A good, strong, attractive title should be chosen. The following examples will indicate the writer's meaning:—"Comments on Castings," "The Edgar Allen Steel Foundry Book," "Grey Iron Gossip."

Handled in the way indicated, it will be found that the catalogue is a potent force in the efficient marketing of castings. At all events, it is a force that the founder cannot afford to neglect.

Graphite and Temper Carbon.

Herren A. Lissner and R. Horny, writing in "Stahl und Eisen" on the subject of temper carbon and graphite as chemically homogeneous forms of carbon, summarise their conclusions as follows:—

By the careful examination of pure graphite extracted from pig-iron and pure temper carbon it has become possible to ascertain comparatively the most important properties of the two forms of carbon. It has been possible to show that both carbons behave exactly similarly when treated with nitric acid; concentrated nitric acid and sulphuric acid; nitric acid and potassium chlorate, and deliquescent sodium sulphate. In particular, both kinds of carbon are converted with the same rapidity into almost identical graphitic acids. The heat of combustion is also practically the same in both cases. On the other hand, temper carbon shows a higher reactivity to oxygen (lower ignition temperature) and also to iron over 800 deg. (in cementation tests).

It is thus also completely proved chemically that between graphite, as found in cast iron, and temper carbon no real difference exists. Both forms of carbon represent the same modification of carbon, namely, graphite. The cause of the greater reactivity of temper carbon observable in certain cases is the extremely fine distribution of this form of carbon.

Professor Pisek, of the Technical High School of Brno, Czecho-Slovakia, at present on a visit to this country, would be pleased to receive catalogues from firms supplying plant and raw materials to foundries. They may be addressed care of The Foundry Trade Journal.

Controlling Moulding Sand.*

By A. A. Grubbs.

While the subject of foundry sands has always been important, it somehow has not claimed attention nearly so much as other materials and processes. Perhaps this has been due to a general belief that sand is not a major factor in determining quality of castings and loss percentages. Recently, particularly in the past two years, much more attention has been given the subject, and the American Foundrymen's Association has considered it of sufficient importance to appoint a committee to study the problem jointly with the National Research Council. The author has had the good fortune to work with this committee and its various sub-committees, and so has been able to keep in close touch with developments.

So little is known about the physical and chemical properties of foundry sands and their relation to the production of castings that one hesitates to speak with authority on the subject. Foundrymen have, however, gleaned some definite facts from various sources, and have discovered certain other facts and principles which have enabled the Ohio Brass Company to accomplish a positive saving in cost of materials and just as positive a reduction in foundry losses.

Properties of Good Moulding Sand.

What distinguishes good moulding sand from poor sand is a certain combination of physical and chemical properties that adapts sand to the economical production of moulds suitable to produce good castings. These properties or characteristics are as follows: Bond, permeability, fineness, clay content, colloid content, chemical analysis, refractoriness and durability. It is by no means certain that this list is either correct or complete. To just what degree each of these characteristics is important depends on the type of work we wish to make. Evidently large steel castings and small brass castings demand quite different requirements of a sand.

The moulder does not concern himself about all these properties. He is interested directly in the bond, texture and permeability of his sand. He wants a durable sand, too, and if working in steel he needs sand that is refractory. These properties might be called the moulding properties of sand, because they are directly related to the workability of the sand. Clay, colloid content and chemical analysis are of interest only so far as they influence or determine the moulding properties.

Difference Between Bond and Clay Content.

Bond has been used by some to denote clay content of sand, while by others it is used to denote the strength or cohesiveness, a property rather than a material. As this latter meaning seems to be coming into more general use we employ the term in that way, reserving the term clay content to denote the material found in sand which cements the grains together. The bond or strength of sand may be measured by methods similar to those applied to other materials. The standard American Foundrymen's Association test is a transverse strength test, but compressive or tensile strength tests have been used by various foundries for the same purpose. The clay content as determined by the standard test is really an extension of the screen test down to those sizes which are too small for wire screens to separate. This clay is merely the material which is fine enough to stay in suspension in water longer than five minutes, regardless of its chemical composition, and probably consists of small particles of hydrated iron and aluminium silicates, fine silica, mineral gels and organic matter.

Clays differ widely in their properties—some are far more sticky than others, and some are more durable as bonding agents than others. The dye adsorption test is a valuable aid in estimating the value of clay bonding material. The quantity of dye adsorbed by a sample of sand is roughly proportional to its colloid content, or content of those particles which are so small that, when shaken up in water containing a small percentage of alkali, a very long time is required for them to settle out, and the finest may never settle out. They are in the neighbourhood of 0.001 mm. (0.0004 in.) in diameter. Because of their very sticky nature these minute particles are of great importance as bonding agents. Test pieces prepared from this colloidal material have shown strength values that exceed that of Portland cement. The test serves, then, as a measure of the bonding value of clay.

Tests for Durability.

Recently there has been much discussion regarding the durability or life of moulding sands. How long will it stand up in service and retain its bond, or how rapidly does it burn out? No standard test for this property has been developed, but two tests have been proposed and are being used with good results. R. F. Harrington, of the Hunt-Spiller Corporation, makes the dye adsorption test on the raw sample, heats it to 315 deg. C. for two hours and then repeats the dye adsorption test. He then calculates the deterioration. H. M. Dietert, of the United States Radiator Corporation, measures the bond strength of the raw sample, heats it to 315 deg. C. for two hours, and then repeats the bond test and calculates the deterioration.

The cause of poor durability in moulding sand is not well understood. It is known that heat tends to dehydrate the iron and aluminium silicates, which are colloidal in nature, and causes the tiny particles to cling together in aggregates. Unfortunately, the addition of water does not restore them to their original state, at least not to any appreciable degree. Mr. Hanley states that the aluminium silicates stand more heat than do iron silicates, hence clays rich in aluminium are more refractory and more durable than those rich in iron. There is considerable experimental evidence to support this theory. Almost without exception best fireclays are rich in aluminium silicates and low in iron. It has been noticed that sands of low durability usually show a higher loss in weight on ignition than do more durable sands. This indicates that part of the bond is due to organic matter, which readily burns out, or possibly that the hydrates are broken down easily. At any rate, it offers possibilities of providing a rapid and easy test for durability.

Permeability Permits Gases to Escape.

Permeability is the venting quality of sand, measuring the ease with which gases can pass through it. It is determined largely by the grain size of the sand and, in a less degree, by its clay content. Some writers have urged that one should aim to keep the grain in moulding sand as uniform in size as possible, so as to obtain maximum permeability. That is, most of the grain should lie on one or two adjacent screens and there should be little or no pan material (through 270-mesh riddle). It is true that uniformity of grain does promote permeability, but it does so at a sacrifice in bond and in texture that determines smoothness of surface. It is not thought practical to maintain any considerable degree of uniformity in grain size, especially when cores are used. The author has successfully varied the permeability in the moulding heaps by controlling the clay content and the average grain size.

Good working qualities in a sand are not assured by proper grain size and proper quantity and quality of clay content alone. The clay substances must be properly distributed upon the surface of the grains. Mere mechanical mixing usually fails to accomplish this; a rubbing or mulling action, under feet of the moulder or under the stroking or beating action of his shovel, or better still in a sand mixer of the muller type, is necessary to wrap the bonding material properly around the grains.

In dealing with sand producers the question has frequently arisen as to whether the foundries can

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* A Paper read before the Pittsburgh Foundrymen's Association.—" Iron Age " report.

expect the producer to deliver sand to them with the bonding material properly wrapped about the grain. In some pits the sand is naturally bonded in good shape; in other quarries the clay and the grain are obtained largely from separate strata and mixed by hand or by machinery. When a sand from one of these latter pits is received it appears to be low in strength, and yet it may have the proper grain size and the proper clay content for a good sand. The bond test and permeability tests alone would mislead one regarding a sand's value because they measure the strength actually present—the sensible bond. The screen test, measurement of clay content and of colloidal content by dye adsorption, indicates a high potential bond, and by mulling this sample a few minutes one is able to bring out this value.

If a facing sand is used as it comes from the producer then one should be careful to see that the bond is properly distributed upon the grains, but where it is being introduced into the moulding heaps in small percentages to renew the life of the old sand, it is not thought that this is necessary. In such a case only the potential bond is interesting.

Sands are purchased according to grain size, clay content, durability and dye adsorption value, with due regard also to uniformity in their production. Instead of checking each truckload as received for bond or permeability, the Ohio Brass Company carries in stock a clay which is not particularly sticky, as the dye adsorption value is only about 200. For bonding purposes a Gallia sand of about 30 per cent. clay is used. This sand has a grain size averaging about 120 mesh, but a finer grade would be better. Its clay is very sticky, the dye adsorption value is about 1,700. These sands are used only to rebond and condition refuse sand from the moulding floors, about 60 per cent. of the additions consisting of this refuse sand.

The refuse sand which the author has been reclaiming consists of the fine material from foundry floor sweepings. The cores, core wires, scrap brass and spillings are hand-picked and screened, using a 12-mesh screen. This fine material, of which about 260 lbs. is produced each week by each floor, has a bond value of about 125 (A.F.A. standard test), a figure too low for moulding purposes in the type of work done. It has an average grain size of about 120, and is more open than the moulding heaps, due to the core sand which it contains. Its clay content is low and of poor quality.

For moulding purposes the management aim to hold their sand heaps at a bond value of 150 to 180 and permeability 18 to 25, depending on the type of work being made on each particular floor. To obtain these values an average fineness of grain of about 150 mesh and a clay content of 7 to 9 per cent. are maintained. Fineness tests are made on each heap at intervals of two or three weeks, to maintain proper grain size and to see that the clay content is suitable. Bond and permeability tests are made daily, and additions are determined by the results of these tests. Low bond is remedied by addition of the Gallia red sand, low permeability calls for increased refuse sand, while high permeability indicates too coarse a grain and is offset by addition of No. 1 sand. If tests show sufficient clay and yet a low bond value, the moulder is urged to cut his sand better so as to distribute the bond properly on the grain, and if immediate results are demanded the heap is put through a Simpson muller.

The sands mentioned above are not added directly to the heap. Additions of raw Gallia red sand result in dirty and even washed castings. The mixture indicated by the test results is compounded and then mulled for a period of about 10 min. before it is put into the heaps. The resulting product has a velvety feel and a bond strength ranging from 180 to 250, according to contents of mixture and time of mulling.

Sand Temper also a Factor.

As another step in studying brass foundry moulding losses, a careful investigation of temper conditions was made. Temper is an important factor because it influences bond, permeability and gas content of the sand and also affects the fluidity of the molten metal. Samples from several floors were tested for bond and permeability at various moisture contents, and it was determined that best moulding conditions could be obtained when the sand carried between 6 and 7 per cent. moisture, a little less being preferable when bond conditions are good. A number of moisture determinations, made on one heap over a period of a week, ranged from 5 to 9 per cent. Ten floors showed practically the same variation. The management then undertook to train the moulders to keep their heaps in a more nearly correct condition by the following procedure:—

The heaps were sampled each day and the moisture was determined immediately. The samples were taken by the moulders themselves and they were asked to express their opinion of the temper. The tests were reported back to the moulders and their instructors. At first these results meant nothing to them, but tact on the part of the assistant, who had had experience as a moulder, soon aroused interest, and they put forth an effort to keep the sand at right temper. A large number of the moulders showed considerable improvement, a few showed little or none. A great deal depended on the attitude of the moulder, the stubborn know-it-all worker getting little benefit from tests. However, as these men are in the minority, the results in general have been good. A special apparatus for determining moisture rapidly was constructed which enabled us to carry on the work more efficiently, so far as time and effort was concerned. The moisture tests are now made at irregular intervals, so as to help the moulder keep the temper of his sand within limits.

Another important factor in foundry control work is the system for determining and recording losses. Each moulder's castings are kept separate until they have been cut from the gates, cleaned and inspected. Moulding losses due to dirt and shifts are charged against the moulder's piece-rate wage. The instructors may earn a weekly bonus by making low losses. The daily loss of each moulder is reported back to the instructor and charts showing the loss of the group under each instructor are posted. The losses on each moulding floor are co-ordinated with the physical characteristics of the heaps and the additions of sand, as an aid to the man handling the sand.

Reduction in Both Cost and Losses.

The results of a year and a-half of control work have been so gratifying that the work is now being extended to the firm's malleable-iron foundry. The reclamation work alone has made no great saving, because the consumption of sand in the brass foundry is not large. It has, however, covered the expense involved in reclamation and control work, giving at the same time the benefits in the way of reduced losses as clear gain.

During 1922 and 1923 the cost of new moulding sand used in our brass foundry was about 4s. 2d. for each ton of good castings produced. This was due to the fact that the foundry was using only high-grade sands and paying high carriage rates. During the past year (1924) this item has averaged only 1s. 11d. per ton of castings, a reduction of 54 per cent.

The reduction in foundry losses has been worth much more. It averaged 8.4 per cent. for 1923. Since that period there has been a marked reduction, the average loss for 1924 having been 4.2 per cent. Dirty castings were reduced 60 per cent. and blows and mis-runs 55 per cent. This reduction in losses is, of course, not due to moulding sand alone. The author would certainly not ascribe it to the use of recovered refuse. The personal factor is such an important element in moulding that due credit must be given to the moulders, their instructors and foremen. There is no doubt, however, but that the sand control work has been a most important factor in two respects.

First, it has helped to keep the sand heaps in good condition and so permits the moulder to get better results; second, it is giving definite knowledge about the condition of the sand, so that no longer is the sand "the goat" for every trouble the moulder may have, the cause of which is not readily apparent.

Innovations in Centrifugal Casting.*

BY CARL PARDUN, Dr.-Eng., Gelsenkirchen.

Innovations do not always mean progress, especially in fields which were opened up by a fundamental main idea out of which the stimulus to further development or to imitation then arose. In the matter of centrifugal casting, the Briede process[1] with movable casting spout must be regarded as fundamental in this sense, as without it centrifgual pipes cannot be produced on an economic basis. The Schalke section of the Gelsenkirchen Mining Company is about to place on the market pipes manufactured by this process, after having thoroughly tested the practicability of their productions in every detail. The credit of having recognised the great importance of producing pipes by the centrifugal process and of having been the first to apply it in Germany is due to F. Burgers, the director of these works.

Most of the innovations seek to undermine the fundamental in question—which, to be more precise, consists in producing a liquid band by a rotary movement and a longitudinal displacement—an endeavour which is also recognisable when, for example, prominence is given to the avoidance of the cooling of the metal on iron revolving moulds, which necessitates a subsequent annealing of the pipes.

As a characteristic example in this connection the process of Moore[2] may first be mentioned, who has taken up again the idea of an iron revolving mould lined with sand. The sand lining has naturally to be renewed for each casting. He hopes to be able to overcome this circumstance by incorporating modern moulding devices. The prepared sand is provided with a coating by special appliances. The distribution and extension of the iron takes place in such a mould without any gate arrangement. It is to the advantage of this process that in English-speaking countries only pipe-lengths of 3.65 m. (12 ft.) are customary. With the German 5-m. lengths the metal could hardly flow through the entire mould from the gate end without a serious loss of temperature. Experience has shown that differences of temperature in the iron readily produce inequality of wall thickness.

The disadvantage of having to renew the lining every time, which naturally takes place outside the centrifugal machine, could hardly be compensated by the elimination of the annealing. Moreover, the solidification of the metal in the sand mould only proceeds slowly; it is therefore exposed a very long time by the influence of the centrifugal force. The great difference in the rapidity of solidification with rotary iron moulds and rotary sand moulds is very clearly shown by the heat coefficients of iron and sand, which are approximately 56:1.[3] During the extended solidification period there is naturally a large deposit of mixed crystals, lighter alloy elements and impurities on the inside, forming a highly wrinkled surface when solidification has been completed. According to Moldenke[4] this phenomenon makes it necessary to smooth the rough inside of the pipes by grinding or coating it centrifugally with concrete.

Meanwhile Arens,[5] a Brazilian, the first collaborator of the American centrifugal expert De-Lavaud, has introduced a special construction for the centrifugal casting of pipes. He has substituted a closed and lined casting pipe for the open casting runner of the Briede process. Solidified residues, impurities and injuries necessitate a freshly fettled casting pipe with every casting; that is to say, there is a similar trouble as with the Moore process. This arrangement cannot possibly mean an improvement when costs and labour involved in the numerous pipes required are taken into account. The pouring of the metal is effected by Arens by means of a bottom plug ladle of calculated capacity, the teeming speed of which can be regulated by altering the height.

The cleaning of an open runner of the Briede type presents no difficulty; nevertheless, with rapidly succeeding castings, the time necessary for the purpose is of importance. With pipes of smaller diameter the capacity of the machine is up to 30 castings per hour. For this reason Holthaus[6] was led to combine several laterally displaceable runners in one group, one of which is carried in front of the revolving mould for the time being, while the others can be cleaned. On the basis of the previously mentioned output figures a considerable number of casting spouts ready for use would thus be necessary with the Arens process. It would be impossible, moreover, to employ the latter process immediately, for, like the Briede process, it provides for a longitudinal movement of revolving mould and casting spout.

The American W. W. Weitling[7] has given the tipping trough a new form, based upon the fact that by winding an inclined plane on a cylinder a spiral line is obtained. Generally the tipping trough consists of a tubular container with a rectangular excision on the upper side, its longitudinal sides running parallel with the axis. Weitling has made the pouring edge wedge-shaped. On the trough being tipped towards the side of the wedge-shaped pouring edge the metal first begins to flow over at the extreme end and then gradually continues along the edge to the other end. If the difficulties generally accompanying the tipping trough had not still remained, such as keeping the pouring edge clean, keeping the trough exactly horizontal and particularly warping, which is difficult to avoid, it might be possible to see in this construction a substitute for the longitudinal movement of the spouts. These difficulties are increased with the length of the castings and the decrease of the wall thicknesses. A freely supported trough filled with iron can with difficulty be kept free from oscillation in the revolving mould; on the other hand, to support it at both sides is detrimental to rapid working.

The centrifugal apparatus known under the name of the Henry-Weitling-Peake process[8] is worthy of notice. Its purpose also is the elimination of annealing, but while retaining iron revolving moulds. From the manufacture of chilled castings it is known that the cooling of cast iron is prevented if the cooling vessel is heated to high temperatures. From this point of view there would be no difficulty in heating the revolving mould to the required temperature; in that case, however, the heat introduced with the individual castings must be carried off. Steam presents too great difficulties for the purpose owing to the high pressure arising with it. It has already been proposed to employ oils[9] with high boiling points as cooling media. The Henry-Weitling-Peake process employs instead mercury to carry off the heat. With an evaporation point of 357 deg. for the mercury, in the range of temperature from 450 to 500 deg. there occur pressures of 4 to 6 kg.-cm², which can still be overcome in the centrifugal machine. To avoid losses the process makes the mercury vapour pass into a second machine after casting, where it is condensed. This process is repeated with every casting. The process further provides for employing in the production of steam the surplus heat of a centrifugal casting plant consisting of several units.

While it is intended by the processes just described to prevent the too-rapid solidification of the metal in iron revolving moulds, Arens, according to a British patent application,[10] lays stress on utilising the high cooling rate for the purpose of strengthening the material. This invention relates to one of the most important points of the centrifugal process, the durability of rotary iron moulds. The great fall in temperature of the cooled revolving moulds produces

* Translated from "Stahl und Eisen."

[1] German Patent No. 242,307 of December 30, 1910; *cf.* "Stahl und Eisen," 44 (1924), p. 909.

[2] American Patent No. 147,105 of October 16, 1923.

[3] "Hütte," Text-book for Foundrymen, 2nd edn. (Berlin, 1922), p. 252.

[4] "Iron Age," 114 (1924), p. 697.

[5] German Patent No. 392,403 of March 20, 1924; *cf.* "S. u. E.," 44 (1924), p. 1532.

[6] German Patent No. 402,803 of January 24, 1924; *cf.* "S. u. E.," 45 (1925), p. 848.

[7] American Patent No. 1,500,428 of March 31, 1922.

[8] "Iron Age," 114 (1924), p. 1674.

[9] German Patent No. 379,032 of December 25, 1922; *cf.* "S. u. E.," 44 (1924), p. 504.

[10] British Application No. 225,818, of 1924.

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during the casting an expansion of the inner fibre and a contraction of the outer fibre. To prevent such harmful stresses Arens constructs the revolving mould of two concentric shells, which under unequal conditions of temperature can expand independently of each other; in addition, they have an annular chamber left free between them, which is filled with mercury or some easily fused metal. This method of construction enables the inner highly stressed and expensive shell to be made thinner, while the outer shell, consisting of ordinary material, is given a longer life.

Wüst has expressed himself in favour of nickel steel as being the most suitable material for revolving moulds. In England and America revolving moulds of chrome-nickel steel are preferred. According to personal information, the latter are said to withstand 1,500 to 1,800 castings. One is readily inclined to make a comparison with the steelworks mould, which is subject to similarly high temperature stresses. For this no better material than hematite iron has yet been found. Tests have shown that satisfactory results are also obtained with this iron for rotary moulds.

The control of centrifugal pipe machines is generally worked from a common driver's stand, and in this connection the starting of the longitudinal movement at the right moment is important. On this depends the attainment of the correct wall thickness at the beginning of the centrifugal process. To render this source of error independent of the skill of the operator, a French invention[11] starts the longitudinal movement automatically by electricity. For this purpose a wire is inserted at the discharge end of the runner, and is connected to a circuit. After the wire is fused by the first iron coming from the runner a second circuit is closed, which cuts in the electro-magnetic coupling of the motor drive for the longitudinal movement. When this movement is completed the coupling is of course cut out automatically. The invention covers other auxiliaries to the centrifugal process without, however, introducing fundamental innovations.

Book Reviews.

Bau und Betrieb moderner Konverterstahlwerke und Kleinbessemereien By Hubert Hermans. Published by Wilhelm Knapp, Halle (Saale), Germany. Price, with paper binding, 12 gold marks; and bound, 13.50 gold marks.

This book, which is a companion work to the author's well-known treatise on modern open-hearth practice, is devoted to a study of the Bessemer and baby Bessemer plant and processes. So far as the former is concerned, it is almost dead in Great Britain, and a perusal of this work makes one wonder whether either the acid or basic Bessemer processes will ever be revived. Suitable raw materials are difficult to procure, whilst the process is one which depends very largely upon the skill of the blower. Fortunately, however, for the popularity of the book, the author has included many subjects related to the process which are common to others. The burning of dolomite, the heating of ladles are but two of many which have wider interest than merely as appertaining to the production of Bessemer steel. Then, too, the author has dealt with the baby Bessemer in great detail, outlining all the modifications, such as the Robert, Tropenas, Stock, Laval, and Levoz. He also includes descriptive matter relative to the blowing engines, the refractories, the ladles, and winds up by dealing with the potentialities of duplexing, or should it not be "triplexing"? as all the Bessemer processes (except the Stock modification) are essentially "duplex."

In his opening paragraph the author sketches the history of Bessemer's early experiments, but we failed to find any reference to Mushet, who is thought by many to have rendered the process a commercial success by the use of ferro-manganese or spiegeleisen.

[11] French Patent No. 567,947 of September 5, 1922.

An important and interesting section of the book which is of equal interest to those in control of basic Siemen's furnace is the handling and treatment of the slags for use in agriculture. The book contains about 250 pages. It is divided into ten main sections, with numerous sub-divisions. In general the illustrations, of which there are over 200, are good; a few, however, could usefully be enlarged.

There is an extensive bibliograph included as an appendix, and we confess that we were a little surprised to find the British standard reference book, so far as the Bessemer process is concerned, omitted. We refer to Mr. Harbord's "Metallurgy of Steel." The index is quite good, but requires a little extending.

The Advertisers' A.B.C., 1925. Published by Messrs. T. B. Browne, Limited, 163, Queen Victoria Street, London, E.C.4. Price 21s.

This book is quite unique. It is, *inter alia*, a very comprehensive press directory. It is probably complete so far as Great Britain is concerned, and very nearly so, so far as the world's dailies and popular periodicals are concerned, but it has not included the foreign technical press. Thus a firm wishing to advertise a specialised article which does not warrant national advertising must not expect to find the lists in this book, and we suggest there is ample scope for its inclusion. After all papers of the standing of "Iron Age," "Revue de Métallurgie" and "Stahl und Eisen," are infinitely more important than the "St. Kitts-Nevis Daily Bulletin." The book contains 847 pages, a large percentage of which is "art quality." The small descriptions of the business possibilities of each country are distinctly interesting.

A Catalogue of British Scientific and Technical Books. Compiled by the British Science Guild and Published by Messrs. A. and F. Denny, Limited, of 163a, Strand, London, W.C.2. Price 12s. 6d.

Being only in a position to review this work so far as it relates to metallurgy and engineering necessarily renders it inadequate. The medical faculty may accord it their full blessing, whereas the astronomer may find it incomplete. From the viewpoint outlined we have little to quarrel with either the arrangement or the completeness, but we were a little astounded to miss Mr. Skelton's book on the Economics of Iron and Steel, the second edition of which has recently been published. As text-books are bound, no matter how constantly revised, to become a little out of date, it is suggested that a list of the standard technical journals should be included, as completeness is its main virtue. We are not particularly enamoured of this type of work. We are never impressed by national or international efforts at collecting bibliographies of published information. In the case of a foundryman wanting a list of works of reference on his subject, he has to buy 9,515 general references, of which perhaps only 100 are of direct interest. Surely, the better way of tackling the question would have been to have issued separate pamphlets covering each branch of industry and science. There would obviously have been a little overlapping, but this could be overcome by such methods as including geological works with both the mining and metallurgical pamphlets, or refractory materials with both metallurgy and ceramics. We cannot imagine that complaints will ever reach the publishers that the binding is unequal to the wear.

To Remove Sulphur from Coke.—Sprinkle the coke with a strong solution of salt and water, and allow to dry before using.

Notch Toughness and Sliding Planes.—"The Connection between Notch Toughness and the Formation of Sliding Planes" is the subject of an article by Friedrich Körner, of Düsseldorf, in "Stahl und Eisen" (July 9, 1925), in which it is shown that a comparative mechanical and microscopical test of ferro-silicon samples showed an increase in the number of the sliding planes formed simultaneously with the increase in toughness, so that it is probable that there is a close connection between the capability of forming sliding planes and the mechanical behaviour of the material.

Standard Costing Applied to Non-Ferrous Foundries.

By H. E. Kearsey, A.C.W.A.

The scheme to be outlined aims at dividing the cost of production into a number of well-defined parts, and making each of these the subject of a periodic account, wherein the value of output or services rendered at standard rates, calculated on a predetermined basis, are offset against the actual charges over the concurrent period.

The predetermination of the standard rates is the essential point of the whole matter, and this will be shown to be by no means the unassailable problem which is conjectured from the term.

In the preliminary stages the foundry manager's estimate will provide sufficient data to launch the scheme into operation—that is, if it is set out in a suitable manner for analysis; it will be obvious that the estimate must be apportioned into similar divisions to those which are to be controlled by the aforesaid accounts.

The number and subject of these control accounts are entirely dependent on circumstances; in this way moulding labour may be controlled by one account, which will include moulding by any method, or a separate account may deal with each of the different groups, viz., bench, floor, machine, etc. The selection of control accounts to be opened is a matter to be decided *in situ* when installing the scheme, and is not a matter of principle.

It may, however, be necessary at the outset to reiterate the well-known main divisions into which cost of production is separated, viz.: (1) Material (direct); (2) Labour (direct); and (3) Expenses.

The methods of costing material, by which is meant the cost of metal incorporated in the castings, are in general so crude that one can hardly term them "costing"; when given even a cursory examination they are clearly seen to be little more than an approximate estimation. The writer includes under this category a very essential subdivision, viz., reserve for loss of metal, although this charge would be classified under expenses by the majority of cost accountants.

The cost of labour in the majority of cases where any costing worthy of the name is in operation is dealt with in quite a satisfactory manner; this is mainly due to the fact that the same methods of wage analysis may be used by foundries as are in practice in other industries.

The last item, expenses, although probably not more important in a non-ferrous foundry than the first of the three, is the subject of discussion which receives most attention in foundry costing circles; the method of absorbing foundry expenses, which is accepted by the majority of cost accountants, is to divide the charges into two classes: (1) Those which are directly influenced by the weight of the castings, and (2) those which are subject to the influence of the amount of labour incorporated in the castings.

It is the former group of expenses which will be considered in more detail to indicate how standard rates may be determined, and how these rates will be used, through the medium of a control account, to check the efficiency of working of the department or plant to which they apply.

It is obvious that the expenses which are to be charged out on a weight basis must be those which are dependent on the weight of the castings; again, the next conclusion we draw will be that these are the charges incurred in melting and pouring the metal, and can thus in future be differentiated either as *melting and pouring expenses* or as *metal expenses*.

The balance of the indirect charges are known as *foundry expenses*, and are charged out in either one of or a combination of the percentage, man hour, or machine rates, whichever method may be considered appropriate.

Proposed Divisions.

When the analysis of charges to be made to *metal expenses* is commenced, while the broad basis is clear, difficulty may be experienced in the practical application; the following groups, which, in the writer's experience is comprehensive, should, however, be sufficient guidance, although modifications may be necessary to meet the requirements of the organisation and lay-out of individual foundries.

(1) Labour charges, inclusive of bonus, incurred in the melting, pouring, and general handling of the metal, both in the raw and cast state, in the foundry.

(2) Fuel, whether coke, oil or gas.

(3) Flux and any other materials used in connection with the actual melting and pouring.

(4) Crucibles.

(5) The charges due to depreciation, repairs, and maintenance of furnaces, hoists, ladles, and other plant and tools used in melting and pouring.

(6) Any allocations of staff salaries which may be deemed necessary to account for time spent in supervision, mixing, etc.

These expenses must be determined weekly, and, contrary to general belief, this task does not, in a well-organised foundry, present the difficulties and inconveniences which appear so apparent to the practical foundry manager; they are the subject of a weekly *control account*, which is debited with the actual expenses incurred, and credited with the sum of the amounts earned by the rates on all castings and chill stick made, swarf re-melted to ingot, and new ingot mixed in the foundry or department of foundry under review.

A standard rate per lb. to cover these expenses is worked out for each kind of metal, and is further analysed out into charges on the different stages of working; in this way the rate for gunmetal will clearly differ from that required for aluminium, and similarly the rate to be borne by gunmetal castings will not coincide with that charged on the preparation of gunmetal ingot.

Varying Rates for Different Alloys.

The necessity for setting up a distinct casting rate for each kind of metal is due to the following causes which affect cost:—(1) The differing temperatures to which each kind of metal is heated in order to mix or pour, in consequence of which there is a different fuel consumption per unit of weight, and (2) the fact that some metals require a greater weight of risers in proportion to the net weight of castings produced, and thus require a proportionately greater amount of metal to be melted in order to obtain an equal amount of castings.

The preliminary steps to determining the rates is to select the metal which is in general use, and to collect as much data as possible concerning its melting cost, production, etc.: the usual selection will be gunmetal, and can be dealt with in a fairly accurate manner.

The maximum and average melting capacity of the furnaces for the foundry under consideration must be carefully studied, and production figures must be estimated, considering the present working conditions, facilities, and amount of labour to be available, with particular reference to gunmetal.

Scheme Illustrated.

For purposes of an illustration, we will suppose the following data to have been collected, preparatory for analysis. The figures given are entirely fictitious, and must not be regarded in any way as practical standards; the actual standard should be at least 30 per cent. lower than the one calculated in the worked example.

(1.) *Average Labour Charges per week*	£30
(2.) *Average Consumption of Coke per 200-lb. Melt*	75 lb.
(3.) *Average Consumption Sundry Materials per ton*	10/–
(4.) *Average Melts per Life of each Crucible*	40 lb.
(5.) *Depreciation, Maintenance, &c., per week*	£15
(6.) *Allocation of Staff Salaries per week* ..	£8
(7.) *Average Weekly Melt*	45,000 lb.

From this data the standard cost per lb. of melting gunmetal may be found and analysed out to give :—

	Pence per lb.
Cost of labour.	0.160
,, ,, fuel	0.112
,, ,, sundry materials	0.053
,, ,, crucibles	0.066
,, ,, repairs	0.080
,, ,, staff	0.042
Total cost per lb.	0.513

Finding the Cost of the Fettled Casting.

Having worked out the standard cost per lb. of melting metal for a particular alloy, we require to utilise this information by calculating what will be the appropriate charges to be made to liquidate its share of the expenses. It will be manifest that the rate must be charged out on the weight of fettled castings, for this is the only reliable one available for costing purposes. The next determination must then be to find the average proportion of net castings obtained from metal melted: the most accurate and practical method entails the taking of gross weights (*i.e.*, by gross weight is understood the total weight of metal poured into the box to make a sound casting) of an average assortment of castings, peculiar to the foundry in question over a period of time, say one month, and comparing these with the actual net weights of the corresponding fettled castings produced: the extra amount of metal to be poured can then be expressed as a percentage on the net weight.

An estimation must also be made for metal melted and poured into ingot at the end of a "pour." This may be due to either the metal being too cold or to no more moulds being available to cast: an allowance of an extra 5 per cent. on the net castings will usually cover this contingency.

It may be argued that this percentage is rather more dependent on the type of castings than on the particular alloy used: this is true to a certain extent, but, while both factors are operative, it is only a practical proposition to deal with the one. To attempt to differentiate between certain classes of castings would be impossible and unnecessary.

At the same time, allowance factors must certainly be made when a foundry deals with such alloys as aluminium bronze, manganese bronze, gunmetal, etc., owing to the technical necessity of having much larger runners and risers on the former alloys than on the latter, with the consequent necessity of melting more metal to secure the same amount of fettled castings.

The determination of rates for other alloys may be made in a similar manner, and these will be utilised as standards: any appreciable alteration in the operative factors will necessitate a revision: but otherwise no changes must be made.

For the rates of expense on the manufacture of ingot, it is sufficiently accurate to accept the standard melting cost of each alloy in question as being the standard to work to.

The calculation of rates of expense to be charged on the production of solid chill stick will entail only the addition of an allowance for treating, painting, and handling the chills (to the rate for manufacture of virgin ingot). The expense rate for cored stick will be slightly higher per lb. than that for solid owing to the higher cost of labour in handling: the cost of coremaking is exclusive to this rate, only the coreing up being chargeable.

The object of the *Control Account* is to compare the value of the output, calculated at standard rates, with the actual charges over a defined period: a schedule of the costs to be charged has already been made, and the application of ordinary costing practice is alone required to ascertain the actual amounts over the period: it may be assumed that this analysis, or something similar, is made in ordinary circumstances.

All the standard rates having been listed, when the output of metal melted, mixed, castings made, etc., is summarised and extended to form the credits, the accounts will be closed. The side on which the balance occurs will be the criterion of the operating efficiency, or otherwise, of the foundry.

The summarisation of the production will not present much difficulty in a well-organised foundry, most of the required data being obtained in the normal routine, and only requiring some further analysis to give all necessary detail.

The advantages of this method of controlling items of cost are manifold, and can, with due justice, be treated only over the scheme in general. At the same time, it will be clear, when judging on this particular division, *metal expenses*, that a much more lucid view may be obtained of the efficiency of production, on a cost basis, than from the general method of *foundry job costing*.

In the latter method very little definite check is available over expenses, for, as they are dealt with in bulk, no comparison can be made of particular items, owing to their dependence on the variety of production, which is rarely analysed with this object in view. With a thorough system of *control accounts*, balanced weekly, each item is under automatic observation.

A weekly *profit and loss account* may be deduced from a summary of the balance of the accounts, for managerial purposes, which will not only act as a constant check on each item of cost, but will also be sufficiently accurate to render a clear view of the result of the week's trading with consequent profit or loss.

The general scheme and its method of operation has now been outlined in enough detail for the foundry manager or director, who has never previously given any thought to the subject, to visualise its possibilities and may even persuade him to embody some, if not all, of its principles into the system of works or foundry costing in which he is interested.

Patent Specifications.

Particulars of complete specifications accepted, furnished by Mr. Eric Potter, Patent Agent, of Lonsdale Chambers, 27, Chancery Lane, London, W.C.2. Printed copies of the specifications in the following list are now on sale.

215,724. AARTS, J. G. Processes and apparatus for reducing iron ores.

238,026. SUNBEAM MOTOR CAR COMPANY, LIMITED, COATALEN, L., and IRVINE, J. S. Metal castings.

238,055. BROWN & COMPANY, LIMITED. Centrifugal casting of hollow bodies of metal.

227,822. NORSKE AKTIESE LSKAB FOR ELEKTROKEMISK INDUSTRI NORSK INDUSTRI HYPOTEK BANK. Electrodes for electric furnaces.

211,894. LENGERSDORFF, N. Furnaces and kilns.

214,648. LEVOZ, T. Electric furnaces for melting and treating ores and metals generally.

237,376. HONIGMANN, L. Annular furnaces with revolving hearths.

237,337. IMRAY, O. Y. Heat treatment of metals and metallic articles.

226,541. GELSENKIRCHENER BERGWERKS AKT GES. Removal of cast hollow bodies from the mould.

237,498. BROWN & SONS (HUDDERSFIELD), LIMITED, D., and BROWN, D. Moulds for the centrifugal castings of metals.

236,229. LENGERSDORFF, N. Furnaces and kilns.

Casting Iron on to Wrought-Iron Bars.—When casting on to wrought-iron bars it is a good idea to split and jag the end of the bar. This will prevent any shaking after being cast, as is often the case in such instances.

"Balance-sheet" of an Electric Arc Furnace.—In "Stahl und Eisen" (July 9, 1925) O. v. Keil and K. Hess furnish a "balance-sheet" of material, electricity and heat in an electric arc furnace. By the most careful control of all losses, in particular those from radiation, convection and conduction, the item of "charging losses," usually remaining hitherto, was eliminated. The electrical efficiency was 81 per cent., the overall thermal efficiency 39.9 and 49.7 per cent. The causes of low efficiency are examined.

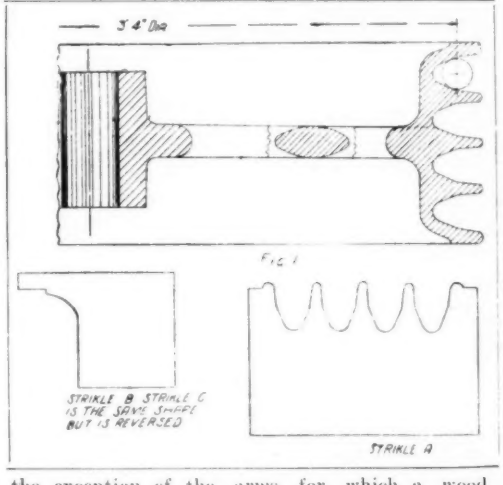
An Abnormal Grooved Rope Pulley Job.

BY J. H. LIST.

Foundries specialising in engineers' castings constantly encounter a number of one-off jobs; such orders can generally be traced to one of the following: (1) Failure of a casting in old plant from wear; (2) alterations to a machine involving a part other than a standard; (3) owing to a breakdown a part is taken to a local shop to save time. This may cost rather more than if the casting were obtained from the actual makers, but obviously in such cases time is paramount; and (4) in the last case there are matching or making-up pieces, some of which present interest, and it is the object of this article to describe one which recently came to the notice of the writer.

A four-groove pulley would not normally be considered a "one-off" job, but the one being described, and as shown in Fig. 1, is definitely "bastard." This abnormal pulley came into being through a shop changing its prime mover, the revolutions of which did not allow of a standard diameter wheel, which would reduce the correct main shaft speed. This main shaft speed was of prime importance. A further interesting point was the misfortune that the alteration in the speed of the main shaft was not discovered until the eleventh hour, which obviously called for a special casting, with a minimum time delay.

After consulting both the pattern shop and the moulding shop foremen, it was decided to make the whole job by means of strickle boards, with



the exception of the arms, for which a wood pattern was provided, so that they could be bedded in. The well-known method of making such pulleys by forming the grooves, though there be as many as 25, with dry-sand cores made in segments and jointed together, by butting end to end up to each other in the mould, was considered. When this method is adopted, however, it is necessary that the grooves be machined out to form true circles, and, in reality, it is better to machine out the grooves, because otherwise the life of the ropes is reduced. It was on this account, that is, the machining of the grooves, that the following method was adopted: The shop that handled the job had no machine sufficiently large to turn the casting, and time was insufficient to allow of taking the wheel to another firm to have the work done. Therefore the trueness and the smoothness of the grooves, apart from grinding by the dressers, was to be achieved as well as possible by the foundry. The work was commenced by making the core for the grooves. This was struck up in loam in one complete ring, from the strickle A, Fig. 1. A ring was cast 36 in. inside diameter, 52 in. outside diameter, and 1½ in. thick. Next a core iron ring was cast 43 in. inside diameter, 49 in. outside diameter, and 1¼ in. thick. On the top surface of this tangs were cast 6 in. apart and 6 in. high; this was to support the core during the roughing up. The plate ring was next laid in a suitable position on the core carriage, and the strickle spindle and socket securely fixed exactly in the centre of the ring, level and square to the ring plate. The strickle A was then fixed to the arm. A ½-in. layer of loam was now placed on the ring, and the core iron ring, after being well clay washed, placed firmly on top, being set in position by the strickle on the arm. The remainder of the core was next roughened up, placing plenty of coke amongst the loam to give vent and to stiffen the loam. The roughening up of this core was the difficult job, as may easily be understood. The overhanging groove projections were, of course, the trouble. In building up the core, pieces of iron rod, ⅜ in. diameter, were laid in horizontally across and right to the end as near as possible to carry the groove cores. These rods were placed about 5 in. apart all round. The core, in this state, was next put into the oven to dry. When dried the core had its finishing thickness put on. The loam used for finishing was much finer and more fluid, and could be applied much easier; even this stage, however, was very highly skilled work. After this layer was dry, the face was smoothed off with a very fine carding paper and given several coats of blacking wash. It was a case where the coremaker could be congratulated on a very fine piece of work.

The next step was the making of the mould. The pattern-maker supplied a boss pattern, six arms, and strickle boards B and C. The bottom part was rammed up, and strickled out with board B, and a joint was made. The six arms and boss patterns were then placed in position, and the top part put on and rammed up. This was then lifted off, finished and skin-dried. The bottom part was then dug out round the outside edge, and strickle C placed on the arm, and the bottom part struck out. The boss and arm patterns were then removed, and the mould finished, runners cut and skin-dried, the centre core was next placed in position, the groove next brought alongside and lifted truly in its position, this core being lifted by three wrought-iron hooks which were cast into the core iron for this purpose. The back of the groove core was then rammed up and properly vented, the holes round the lifting hooks in the core were made up, and the top part of the mould placed on, cramped down, and weighted, and prepared ready for running. When the casting was fettled and dressed up, it was surprising to see how clean and true the grooves were.

The job was turned out in about four days.

Smoke Abatement.

Perhaps smoke abatement is viewed by foundrymen through spectacles a little different from the man in the street. For the former it is a technical problem which has to take its proper perspective in relation to industrial conditions. The Smoke Abatement League—a title we would prefer to see replaced by the Smoke Nuisance Amelioration Society—is to hold its annual conference at Buxton from October 2 to October 4. From the constitution of its council, it appears to be made up very largely of medical officers for health, with a large sprinkling of pure scientists. Obviously smoke abatement is bound up with the economical production of commercially saleable products, and a minimum of smoke production can best be effected by co-operation between the idealists and manufacturers. We suggest that bodies of manufacturers should be represented at this conference adequately to emphasise the manufacturing aspect of smoke abatement. Often it can be accomplished with added technical efficiency, but where a reducing atmosphere is essential, technical and economic difficulties arise. The secretary is Mr. C. Elliott, of 33, Blackfriars Street, Manchester.

A Good Tar Paint for Castings.—Mix together 8 parts of common gas tar and 1 part of naphtha. Let the solution stand for a few minutes, and mix again.

New Fettling Methods in an American Automobile Foundry.*

The new cleaning room of the Ferro Machine and Foundry Company, Cleveland, Ohio, is laid out and equipped for the economical cleaning of cylinder castings through the saving of man power. Work moves, as far as possible, in a straight line from the time the castings reach the department until they are cleaned and loaded on trucks for despatch. Handling is done largely on conveyors, so that only two trucking operations are required for the largest production unit that handles Chevrolet cylinder castings. The first trucking is hauling the castings from the foundry and the second is conveying them from the chipping benches to the water testing equipment.

With the plant carefully laid out for a certain fixed production, the tumbling barrels, sand blast rooms, chipping benches and other equipment are provided in sufficient numbers to take care of the various operations at the designated production speed, so that an even balance is maintained and the work progresses continuously from start to finish. With the established speed schedule, a Chevrolet cylinder reaches the loading car three hours after leaving the core knock-out machine. The general plan of having each part keyed up to a certain production rate is applied also to the capacity and speed of the conveyors. The cleaning department has a capacity for cleaning 3,000 cylinders in a 9-hr. day, 2,000 of the Chevrolet type and 1,000 cylinders of the larger types.

The cleaning department is a modern type of factory building, or rather three connected buildings, of brick and steel construction with steel sash, and is located a short distance from the foundry. The cleaning room is 100 × 204 ft. Adjoining it on one side is a core knock-out department 70 × 100 ft., and at the opposite end a salvage department, 60 × 160 ft.

Vibration used for Removing Cores.

Cylinder castings, after being shaken from the flasks on the moulding floor in the foundry, are loaded on trucks and are stored in a yard for about half a day, or until they have cooled. These trucks have a capacity of 25 Chevrolet cylinders or about 17 larger motor cylinders. Petrol tractors are used to haul the trucks from the foundry to the court and thence to the core knock-out room.

A battery of six Stoney patented core knock-out machines, arranged in parallel lines, is located in the knock-out building. A seventh knock-out machine will be installed shortly. The castings are lifted from the truck and set on the supporting bracket of the knock-out machine by means of a chain hoist located above each machine. When the air is turned on the core is shaken out by the vibrating action of the machine in from 3 to 6 seconds. The sand drops through the floor on to a belt which conveys it to the end of the building. It is passed over magnetic pulleys to extract the metal and is elevated to a 75-ton storage hopper over a railroad track outside. From 25 to 40 per cent. of this sand is taken back to the foundry and used again. The remainder is hauled to a dump.

At the rear of the knock-out machines is a plate-type power conveyor, 147 ft. long and 20 in. wide, that extends into the cleaning room, where it connects at right angles with a similar conveyor that serves the tumbling mills. The castings are discharged from the end of the first conveyor to the second conveyor. Both conveyors are driven by variable speed motors providing a conveyor speed of from 7 to 13 ft. per min., but a speed of about 10 ft. per min. is that required for full production.

Cleaning Automobile Cylinders by Barrelling.

Chevrolet cylinders are all cleaned in tumbling barrels and the larger cylinders in sand-blast rooms. After the cores are knocked out the smaller cylinders are placed on the power conveyor by means of the chain hoists and the larger cylinders that are to be sand blasted are placed on trucks and carted to the sand blast rooms.

There are 20 tumbling barrels in two parallel rows, ten on each side of the conveyor. These are square barrels, the first three being 40 × 40 × 84 in., and the remainder 38 × 38 × 72 in. Each barrel has a capacity of 26 castings and the cylinders are tumbled for 2 hr. One 30-hp. motor is used to drive two barrels, the drive being through a clutch and gears. Above each barrel is a chain hoist for handling the barrel lids. Another chain hoist is located above each motor so that, if repairs are needed, a motor can be removed quickly and another substituted. The castings are handled to and from the barrels by hand. The Chevrolet castings weigh 120 lb. and can be easily handled by two men. A platform at the proper working height is located between the conveyor and the tumbling mills.

Protecting the Fettlers.

At the rear of each row of tumbling barrels is a row of 20 chipping benches. After tumbling, the castings are taken from the barrels by hand and placed in front of the adjoining bench. Each chipper has a complete installation, with individual connections for air and light. Suspended on a chain from frame work of angle iron construction, a wire mesh screen 4 × 5 ft. separates the chipping benches, so that a workman is fully protected from metal flying from the bench of the adjoining chipper.

Based on a production of 2,000 cylinders in nine hours, and an average chipping speed of seven pieces per hour by each chipper, the unit requires 32 chipping benches, but a total of 40 is provided to assure ample chipping output in case some of the chippers are absent. After chipping, the cylinder is water tested for leaks in the jackets and valve pockets and then inspected in a test fixture, one of which is provided for each kind of cylinder for checking all surfaces that are to be machined. After testing, the castings are placed on roller conveyors on which they are pushed a short distance to the side of the building and through doors into box cars. There are three loading doors and two parallel double tracks, with a capacity of six cars. The tracks are depressed to place the car floors on a level with the cleaning room floor. Cars are spotted side by side on the two tracks, those on the outer side being loaded first, the movable roller conveyor extending through the first car into the car on the outer track.

Such cylinders as are machined in the plant are trucked to the machine shop instead of going to the cars. Rejected castings are marked after the water test and inspectors decide whether they are to be salvaged or scrapped. If they are scrapped, they are loaded on trucks and sent to the cupolas.

Swing Grinders Provided for Large Cylinders.

The larger cylinders, for Paige, Chrysler and Hupmobile cars, on leaving the core knock-out machines are placed on trucks and taken a short distance to the sand-blast rooms. These are four in number, 10 × 10 ft., built in double units and located side by side. A very efficient method is provided for handling the cylinders from the trucks to the sand-blast room. The castings are picked up with a pneumatic hoist operated in front of each pair of rooms and the hoist lowers it on to two hooks suspended from a trolley, the track of which extends through the rooms and circles around the side to the front.

After sand blasting, the castings are lowered to the floor at the rear of the sand-blast and the trolleys carrying the handling hooks are pushed round to the front of the sand-blast rooms for reloading. At the rear of the sand-blast rooms are three swing-type grinders, for each pair of sand-blast rooms, which remove the fins, etc. Then the castings pass along to chipping benches arranged in rows and similar to those used for handling the smaller castings. After grinding and chipping, the cylinders are water tested, inspected and loaded on cars.

At one side of the knock-out room are several small tumbling barrels for tumbling pistons, cylinder heads and miscellaneous castings and three small grinding machines are provided for grinding these castings.

* Extracted from an article in *The Iron Age*, "Cutting Cleaning Room Costs."

Reclaiming Castings by Welding.

As defective castings cannot be avoided, these must be reclaimed, when possible, to attain the greatest economies in production costs. The salvage department provided for this work is a complete and well-arranged unit with equipment for cleaning and grinding the castings after welding, so that when they leave the department they are ready to load on cars. Castings having reparable defects are placed on a roller conveyor that extends from the end of the cleaning room along one side of the salvage department. In this department is one oil fired pre-heating furnace for heating before welding. This furnace is operated at a temperature of 590 to 650 deg. C. The castings coming from the roller conveyor are placed side by side on a table that extends through the furnace and are pushed through the furnace by a pneumatic pusher located at the front of the table. The furnace has a capacity of about 20 castings and they remain in the furnace until they reach a cherry red heat, when they go to the welding unit.

Five oxy-acetylene welding stations are provided for welding the defects. Formerly the cylinders were placed in sand after welding, so that they would cool slowly. For this method of cooling the use of cooling pits has been substituted and the new method is found more satisfactory in that the cooling is more uniform and fewer hard spots are found in the iron when the cylinders are machined. Ten pits, located near the centre of the room, are of brick construction built up from the floor level. The pits, 3 ft. wide, 2½ ft. high, 36 ft. long, are located side by side, with corrugated sheet covers that are easily removable. Openings are provided in the brick partitions between the pits, to allow the circulation of air. The castings are left in the pits about 3 hours. A trolley system is provided for handling the castings from the roller conveyor to the furnace and on to the welding machines and pits. After leaving the pits the castings are handled on roller conveyors.

After cooling in the pits the castings are inspected and the welds are ground with portable electric grinding machines suspended from above, and counter-weighted so that the machine operator can raise or lower his grinder as desired. Two sand-blast cabinets are provided for cleaning the cylinders after grinding. Following sand blasting they are ready for shipment.

The dust-arresting equipment is located in a separate building adjoining the cleaning department. There are two dust-arresting units for the four sand-blast rooms, two for the large tumbling barrels, one for the small sand-blast cabinets and one for the small tumbling barrels. The arrangement of the dust-arresting equipment is rather unusual in that the blowers are located beneath the screening equipment. The structure housing the equipment is of sufficient size to provide open space and head room for a railroad car beneath. The material collected by the dust arrestors is dumped directly into cars from hoppers beneath the arrestors.

The entire plant was designed and erected under the direction of the Stoney Foundry Engineering and Equipment Company, Cleveland. The dust-arresting equipment, tumbling barrels and the cleaning room sand-blast equipment were supplied by the W. W. Sly Mfg. Company and the sand-blast cabinets in the salvage building by the American Foundry Equipment Company. The power conveyors were built by the C. O. Bartlett and Snow Company.

Chilled Iron Castings.

American Patent No. 1,525,027 granted to the W. J. Early Sons' Foundry Corporation of America, relates to an alloy capable of taking a chill in a sand mould without the use of metal chills or moulds. The alloy consists of T.C., 2.25 to 3.75; C.C., 1.0 to 2.25; Si, 0.75 to 1.50; Mn, 0.20 to 0.70; S, 0.05 to 0.25; and P, 0.25 to 0.75 per cent. The depth of the chill in the finished casting is controlled by primarily varying the pouring temperature, but the sulphur content is also used.

A New Type of Sand Mixer.

We are indebted to Blackfriars Foundry Equipment Company, of 181, Queen Victoria Street, London, E.C.4, for details of a new type of American sand-preparing machine, the marketing of which they have recently taken up for Great

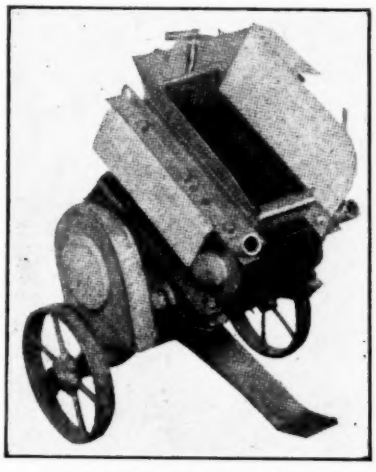


FIG. 1.—A PORTABLE MODEL.

Britain. One model, B, is illustrated in Fig. 1. It has a capacity of 400 lbs. of sand per minute, and is driven by 1 h.p. motor, weighs 570 lbs., and is portable. Other models C and D are larger and have a capacity of 700 and 1,000 lbs. of sand per min. The machine, known as the Rover, removes all scrap from old sand, breaks up lumps, aerates

FIG. 2.—DELIVERING SAND 14 FT. FROM THE MACHINE.

the mixture and delivers it in such a manner that it can be received directly into a bin or bucket for ready storage or transport. Fig. 2 shows Model D in action delivering sand 14 ft. away from the actual machine.

Chilled Castings.—In an article on "Chilled Castings" ("Stahl und Eisen," July 9, 1925) Dr. P. Goerens and Dr. H. Jungbluth, of Essen, give a survey of the results of past researches and report on investigations in connection with experimental chilled cast-iron cylinders. It was found possible to determine the influence of the carbon on the hardness by means of curves, and to show the influence of the carbon, silicon and casting temperature on the hardening depth. In particular cases the wall thickness of the chills was shown to have an influence. It is shown how measurements carried out under working conditions can be utilised by the examination of mass calculations. The results observed in the test cylinders were thus partly confirmed and partly extended. Finally, by combining the values obtained in the writers' researches with those obtainable from the literature on the subject, an ideal curve for the influence of silicon on the hardness depth has been drawn.

Some Frémont Tests on a Varying Section of Grey Iron.

Commenting upon an article contributed by Mr. Ivan Lamereux to "Revue de Fonderie" on the subject of "Molecular Equilibrium of Grey Iron Castings," Mr. J. Varlet, the well-known Belgian foundryman, made the two castings shown in Fig. 1, and carried out tests with the Frémont machine. The iron contained 1.6 silicon, 0.6 manganese, 0.09 per cent. sulphur, and phosphorus 0.39. As would be expected, the experiment showed that where the grain is closer—that is, in the thinner sections—the strength was higher. Additionally, tests taken from the skin gave higher figures than those taken from the centre. The strengths varied from 36.9 kilos to 23.2 kilos. He concludes by asking what are the differences in strength in large complicated castings of varying sections and having differences in contraction and possessing abnormal tensions? In Fig. 2 are plotted the results obtained.

These experiments show the necessity of making test pieces correspond so far as is practically possible with the average thickness of the casting, as is proposed in the Institute of British Foundrymen's Tentative Specification.

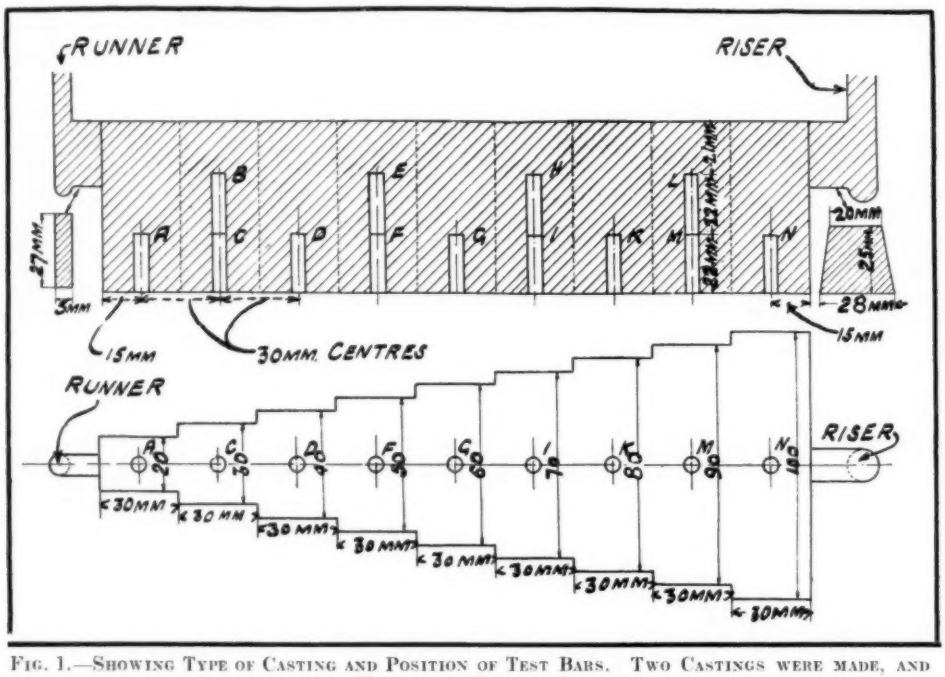


Fig. 1.—Showing Type of Casting and Position of Test Bars. Two Castings were made, and the Following Results Given:—

Casting No.	A	B	C	D	E	F	G	H	I	K	L	M	N
1	34.4	28.0	31.2	36.0	26.4	33.6	32.8	25.6	32.8	32.0	24.0	28.8	32.8
2	36.8	29.6	32.8	32.8	28.8	35.2	32.8	25.6	36.0	23.6	23.2	32.8	33.6

Removing Sand from Light Castings.—Pickle for 10 or 12 hours in the following solution:—Water, 5 parts; oil of vitriol, 1 part, adding the acid slowly to the water.

Americans to "Sand-Spin" Cast-Iron Pipe.—According to the "Iron Age," the American Cast Iron Pipe Company, of Birmingham, Ala., are installing in a specially laid out shop twelve centrifugal pipe casting machines capable of making daily 500 tons pipe of 4, 6, 8, 10 and 12 in. dia. The plans call for a battery of cupolas and other auxiliary plant.

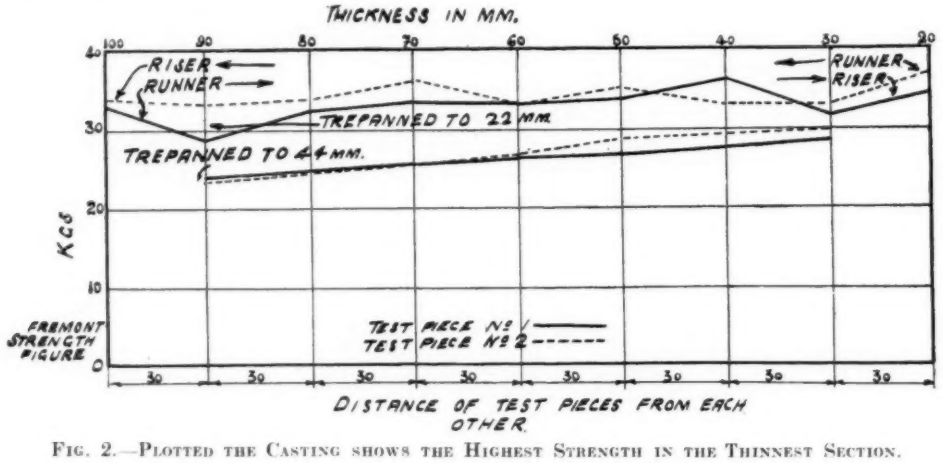


Fig. 2.—Plotted the Casting shows the Highest Strength in the Thinnest Section.

Taking Impressions.—For taking impressions of unorthodox castings the following is highly satisfactory:—Mix together 4 parts of black resin and 1 part of yellow wax. If a flexible composition is required, then melt glue (12 parts), and then add black treacle (3 parts). This composition may also be used for taking casts.

Salvage and Reclamation of Aluminium-Alloy Castings by Soldering and Welding.*

By Robert J. Anderson and M. Edward Boyd.

INTRODUCTION.

The object of this paper is to discuss the economic and metallurgical aspects of the salvage of defective aluminium-alloy castings by the usual methods of soldering and welding. As is well known, in the production of aluminium-alloy sand castings, a variable percentage of the castings poured, say, 15 per cent. on the average, is spoiled because of the occurrence of certain typical defects, *e.g.*, cracks, blows, draws, holes, *et al.* Certain of these wasters admit of salvage by effecting repairs at the defective places, and, in American foundry practice, welding and soldering are the two methods most extensively applied.

Since aluminium became an important engineering material for construction, much time has been spent in developing methods for making joints in the metal and its alloys, and at the present time the usual methods employed in practice are oxy-gas welding and soldering. Electric-resistance and electric-arc welding methods are in use, but these have not yet found general application. The literature on soldering and welding aluminium and its light alloys is quite extensive, but most of the published papers deal with the technique of making welds and soldered joints, and the metallurgical aspects of the subject have been considerably neglected. At the present time, welding is extensively used, in the aluminium industry, as a manufacturing process for the construction of large tanks, vats, and other vessels for use in the chemical industry; in the manufacture of aluminium cooking utensils, *e.g.*, for attaching cast or stamped spouts to spun bodies; in the repair of broken automotive and machinery parts in aluminium alloys; and in the salvage and reclamation of castings in foundry practice. Soldering should really have very limited application in aluminium work, as will be shown later, but it is employed in the salvage of castings and also for making joints.

With simple castings, the loss due to wasters may be quite low, say 4.7 per cent., but in complicated castings, like crank-case upper halves for 8-cylinder motor cars, it may be as much as 20 to 25 per cent. on the average. Of these losses, some 50 per cent. is reclaimed by soldering and welding, and additional reclamation is made of porous and leaky castings by treatment with sodium silicate.

Casting Losses in Aluminium-Alloy Sand Founding.

In the production of aluminium-alloy castings in the sand foundry, the castings made during a day's run may be divided into three classes; viz., (1) good castings, which pass inspection; (2) castings with remediable defects, which can be salvaged; and (3) totally defective castings, which are immediately returned to the melting room. Even with the best practice, a certain number of the castings produced will be found to contain defects, and these defects may admit of repair.

The question of casting losses in aluminium-alloy foundry practice has been treated at length by one of the writers,[19]† and the types of defects encountered and the causes for losses have been discussed. In the rough inspection of castings on removal from the moulds, the parts may be sorted into three groups, as above indicated. On rough inspection, castings are rejected because of the presence of certain typical defects, among which cracks, surface sand holes, crushes, run outs, misruns, cold shuts, thin walls, blows, draws, and defects due to the coring are the most prevalent. These sundry defects are directly traceable to one or a combination of causes including too high and too low pouring temperatures, core shifts, sand in the mould and dirty moulds, cope drops, improperly made moulds, dirty cores, broken cores, cores too hard or too soft, lack of chills, improper gating, wet chills, improperly tempered sand, poor quality of metal, etc. Blowholes, porosity, and unsoundness are related defects of common occurrence, but these are not normally found on rough inspection, and porosity is normally examined for, *e.g.*, in the case of castings which should be leak-proof such as carburettors, manifolds, crankcases, etc., during the course of a special test for this defect. Porosity and related defects, and hard inclusions, may be uncovered on machining.

Of course, it is difficult to draw sharp lines of demarcation among good castings, those with possibly remediable defects, and totally defective castings, and in order to govern castings inspection and salvage it is necessary to adhere to some simple, practical, and understandable set of inspection and salvage specifications. Whether any casting shall be accepted, rejected, or admit of attempted salvage must depend upon the character and amount of the defects, upon the use to which the casting is to be put, upon the amount and character of the subsequent machining in relation to the defects, and upon the inspection specifications. It is quite impossible to state broadly what kinds of defects may be repaired. Specific defects may be large and serious, or situated at such positions on castings that repair is inadmissible, inadvisable, or impossible, or else the same types of defects may be small and innocuous. A defect which may cause one type of casting to be thrown out may be of no importance in another casting.

Speaking first of the usual defects encountered on rough inspection: it may be stated broadly that defective castings containing certain types of defects, provided these are not seriously large or situated at particular positions on the castings, may be reclaimed. The preferred method of salvage is to weld the defective places, but soldering is employed for certain kinds of defects. In a general way, it may be said that small cracks, local porosity, draws, surface sand holes, certain types of mis-runs and cold shuts, blows, and the like may be repaired by welding. Soldering is actually employed for repairing blows, cracks, draws, and other defects, but it should be emphasised that soldering should not be applied to the salvage of castings which contain large and serious defects such as long cracks. Soldering should be admissible only for the repair of small and innocuous defects and to improve the appearance of the finished casting.

In the matter of porosity and unsoundness in leak-proof parts, salvage is normally affected by treating the castings, shown to be porous, with a solution of sodium silicate followed by baking.

In considering the salvage of castings, differentiation should be made between defective castings found on inspection in the foundry and defective castings found on machining. A casting which may pass foundry inspection may be found, on machining, to contain serious internal defects and flaws, owing to the foundry practice. Hard inclusions, strain cracks, and unsoundness may be uncovered on machining, and castings containing such defects may admit of salvage. Moreover, on machining, castings may be undercut, broken, or otherwise spoiled, and repairs may be effected. The total amount of machine-shop returns is variable from 0 to 4 per cent., with an indicated average of 1.5 per cent. The return on Liberty aviation-engine castings was about 1 per cent.

Economic Aspects of Castings Salvage.

While there is a large field of application for welding in the production of aluminium and aluminium-alloy manufactures and in the repair of parts failed in service, especially broken automobile castings, the employment of welding in the foundry as a means for salvaging defective castings is of great commercial importance. Soldering is, of course, of little importance in the production of manufactures, but it does have some legitimate application in castings salvage.

In the job-welding shop, the bulk of the aluminium-alloy work presented for repair consists

* Extracted from a Paper presented to the American Foundrymen's Association.

† Numbers refer to papers listed in a bibliography to be published as an appendix.

of broken, or otherwise damaged, crankcases, gear boxes, housings, and other automotive castings. The problem of the job welder is the repair of such broken parts so that they may be put into service with the least possible delay and at substantial saving over the cost of a new part. Welded repairs are made upon any type of break that admits mechanically of repair by the process, and no restrictions are laid down as to what types of repairs may be effected. The welded joint of a fracture may be built up well so as to ensure ample strength, and large fractures, holes, and breaks may be repaired with no special regard for appearance. In the case of repair welds, the customer understands that he is getting a repair job, and he looks for service rather than appearance and technicalities.

The problem of salvaging defective castings in the foundry is considerably different from that of repairing old broken parts. In foundry practice, salvage is effected for the purpose of making merchantable castings from parts that would otherwise be scrapped because of specific defects, and the economic importance of reclaiming castings containing remediable defects will be shown in later paragraphs of this section.

In the case of castings found to be defective on inspection in the foundry and of new castings returned from the machine shop, care must be taken in salvage repairs so that the part will not have the appearance of having been repaired, or at least a salvaged casting should not have the appearance of having been seriously defective prior to repair. Solder repairs should be made only rarely (cf. Metallurgical Aspects of the Salvage Problem, below), while weld repairs should not be made on stressed members or on parts whose failure in service might endanger life. A single failure traceable to a casting inadvisedly salvaged by welding or soldering would be many times more expensive to a manufacturer of motor cars through damage to his reputation than the cost of a new casting. However, even with strict limitations imposed on foundry salvage, there is considerable scope of application for weld repairs to defective new castings. It should, of course, be emphasised that such salvage should be carried out only under expert supervision and according to practical and sufficiently rigid specifications.

The importance of castings salvage in aluminium-alloy foundry practice may be properly appreciated only by a consideration of casting losses and the relation of possible salvage to the wasters produced. Table I gives some data on casting losses

TABLE I.—*Casting Losses and Salvage of Castings by Welding.*

Type of casting.	Total number of castings poured.	Number of castings accepted on rough inspection.	Number of castings totally rejected on rough inspection.	Number of castings amenable to salvage by welding.
Variety of automobile castings ..	2,093	1,018	267	808
Motor crankcase	502	270	18	214
Differential housing	438	242	100	96

and salvage by welding in the case of aluminium-alloy castings produced in an automotive foundry. Taking the case of the variety of automotive castings, out of 2,093 castings poured, about 51 per cent. were found defective on first inspection, and of total defectives some 39 per cent. contained defects which admitted of repair by welding. In the other two examples shown in the table, the importance of welding as a method of salvage may be noted. In discussing this matter with three representative founders, the following information was furnished*:—In a large automotive foundry, the average casting loss for a variety of automotive castings, but principally crankcases for an 8-cylinder motor car, is 20 per cent., *i.e.*, 20 per cent. of the castings poured are rejected on first inspection. Of this loss, some 90 per cent. is salvaged by welding. In another automotive foundry, the average casting loss for 6-cylinder crankcases is 10 per cent., and half of this loss is saved by soldering small and localised defects. In still another plant—a large jobbing foundry—the average casting loss is 8 per cent., and some 60 per cent. of the loss is reclaimed by soldering or welding, depending upon the type of defect.

Estimation of the monetary value of the savings effected in the American industry has been made by the writers on the basis of average figures for casting losses, percentage of loss reclaimable, the cost of scrapping castings per pound, and the total production. The first three items are very variable in different plants, depending upon local conditions, but for purposes of calculation the following average figures may be taken, viz.:—Average casting loss, 15 per cent.; percentage of loss reclaimable, 50 per cent.; and cost of scrapping castings per pound, 7½d. The total output of aluminium-alloy castings may be taken as 100,000,000 lbs. per annum. Then, the saving owing to reclamation is of the order of £225,000 per annum in the United States. For a plant with a production of 10,000,000 lbs. per annum, the saving should be of the order of £20,000 at least. This is a very substantial item, and indicates much better than a simple statement the necessity for first-class supervision in the salvage department.

Specifications for the Salvage of Aluminium-Alloy Castings.

Generally speaking, the problem of salvaging defective castings in aluminium-alloy foundry practice is not handled in a systematic manner and under metallurgical supervision. Such salvage is usually left in the hands of an inspector, who, in the interest of production, turns all defective castings over to a welder, who proceeds to plaster them with solder or else welds everything indiscriminately in the attempt to save all defectives. Although a considerable number of castings are reclaimed by this method of disposition, the general result is that castings which should be welded may be soldered or *vice versa*, and many castings may be ultimately scrapped because of poor repair technique, cracks on welding, or unsightly welds. Moreover, in this way castings containing large and serious defects may be repaired and put into service at the risk of life or the reputation of the manufacturer. Inspection of defective castings under competent metallurgical supervision is the only method by which it is possible to determine what defects may be safely and economically repaired.

It may be stated broadly that small cracks, surface blows, sand holes, cold shuts, draws, and breaks are representative of the defects that are repairable by welding. It should be pointed out that in some plants all salvage is done by welding, while in others soldering only is used, while in still others soldering or welding is employed, depending upon the nature of the defect. Both soldering and welding have distinct applications in castings repair, and either one should not be used to the exclusion of the other. However, a safe rule to follow is to exclude the use of soldering and to weld all repairable defects. Soldering is prohibited entirely on rough castings in some shops, but is used on machined and semi-finished castings which cannot be welded because of warping that would ensue. Soldering may be permitted where the joint to be made is free from strains of any kind and where it is not to be exposed to moisture or other agents that would induce electrolytic corrosion between the solder and the casting. Actually, the use of soldering should be quite rigidly restricted, and its primarily useful purpose is to improve the appearance of a finished casting.

In considering the types of defects which admit of repair, it is of rather more than passing interest to consider specifications governing salvage. So far as is known, definite salvage instructions are issued in but few plants. The instructions issued at the plant of a motor-car manufacturer and those governing the reclamation of castings for the Liberty 12-cylinder aviation engine may be cited as representative.

(To be continued.)

* Private communications.

A World Outlook for Foundrymen.*

By H. Cole Estep, Cleveland, Ohio.

In the years which have passed since the armistice there has been a great quickening of mutual interest among casting manufacturers throughout the world. Not only has the foundry industry of the United States been brought into closer contact with that of Europe, but European foundrymen have become much better acquainted with each other. Everywhere there is greater unity. This happy condition is the result of efforts initiated largely by the American Foundrymen's Association, which have grown into the dimensions of a world movement that may easily have an important effect on the future course of industrial and even political history.

The significance of this great development in practical internationalism within the industry in which we are all so vitally interested is not yet fully manifested. We are in fact participating in a movement the whole power and sweep of which we as yet have difficulty in appreciating. Almost alone among the engineering trades, foundrymen in America now have the benefit of a world outlook and worldwide connections, which offer benefits of a very tangible kind. Without giving up any of our natural advantages or American characteristics we are in a position, as an industry, to make our influence felt abroad as it has never been felt before, and to absorb from the Old World much that would be beneficial to our own operations. This is what is meant by practical internationalism.

We have no desire to Americanise the foundry business of Europe, nor would we consent to any Europeanising of the activities within our national frontiers. But the channels of communication which recently have been opened up between the American Foundrymen's Association and the leading European foundrymen's organisations show that there is much to be gained on both sides by closer contact and knowledge of one another's methods and technical problems.

Beyond this it is beginning to be clear that in thus serving their own ends by getting together internationally, the foundrymen of the world are contributing in no small measure to the solution of a much larger problem—namely, to the cause of world peace itself. For peace comes of understanding and it is in the professional and business arenas that most international misunderstandings originate. Therefore the burden of promoting concord rests especially heavily on the shoulders of technical men and industrial leaders.

Foundry Industry Elevated.

As Mr. Oliver Stubbs, twice president of the Institute of British Foundrymen, pointed out at the Newcastle-on-Tyne convention, the political troubles of a postwar world will not be solved until business and professional men show a greater willingness to make their influence felt and to bring their specialised knowledge to bear. "Therefore," he said, "the value of these international contacts between foundrymen reaches far beyond the confines of our own industry. We are promoting the peace of the world by getting together." To which might be added that no set of men have done more since the war along this line than the producers of castings. The development of friendship in the past six years between the foundrymen of the world has been tremendous. All nations have contributed. One of the by-products of their efforts has been to lift the foundry industry everywhere to a plane of greater importance and dignity in the organisation of human affairs.

From this improved situation the casting manufacturers of all countries are benefiting, indirectly and directly. The primary purpose of the American Foundrymen's Association is to promote the interchange of technical information. The growth of the society and the position of influence to which it has attained is sufficient proof of the tangible value of the work it is doing. In the light of this, the usefulness of the ten papers on practical foundry subjects which have been contributed to the proceedings of the American Foundrymen's Association in the past three years by foreign authors can be judged. These papers were written by men who have the highest standing in their respective countries. To appreciate their importance it is necessary only to review the list of titles and authors presented herewith. These papers represent a volume of information on European foundry methods which greatly exceeds anything of the sort made available to American producers during the decade or two prior to the war. A point to be emphasised is that these valuable contributions to our foundry literature have been written expressly for American readers, which means that they contain far more than the usual number of suggestions which American foundrymen could utilise profitably in their daily work. In addition they are reinforced in most cases by a full discussion by leading American foundrymen, who have pointed out the exact way in which the suggestions offered can be applied to our own conditions.

All this is a result of the growth of international co-operation which has been outlined briefly in the foregoing, coupled with the specific arrangements for interchanging information with European foundrymen's associations which have been perfected by the American Foundrymen's Association since 1920. Some further details of this exchange of papers arrangement will be given later on in this communication. At present it is sufficient to point out, as further evidence of the great strides made by the foundry industry recently, that in no other branch of the engineering trades has anything of the sort been attempted, so far as the author is aware. The foundrymen of America alone are possessed of a working arrangement whereby the best European thought on the technical problems of their business is brought to their doorsteps.

European Exhibitions.

There are at least two other directions in which foundrymen are reaping benefits from their improved international outlook. One is found in the spread of the foundry equipment exhibition idea to Europe. Since the war there have been four such displays abroad. The first one was in Belgium, September 18 to October 10, 1921, at which there were 80 exhibitors. This exhibition, which included, like its successors, considerable American machinery, was held in Liege and was so successful that it was continued for a week beyond the original closing date. In 1922 there was an international exhibition of foundry supplies and equipment in Birmingham, England, June 15-24, at which there were 120 exhibitors. Paris held the stage in 1923, when a display of 100 exhibits was held September 2-16, in connection with the first postwar International Foundrymen's Congress. Last year there was another exhibition in England, which was held in Birmingham, June 19-28. These foreign exhibitions, although on a smaller scale than those held by the American Foundrymen's Association, possess one feature of great practical value. There have been included in every case representative displays from five or six different countries on both sides of the Atlantic, thus affording the visitor a unique opportunity to study the development of foundry equipment and machinery comparatively. Those who have not been able to attend in person have had the benefit of extensive reports in the technical press. There have also been two or three such exhibitions in Germany since the war. There are no records of any comparable activities in the exhibition line in the 20 years from 1894 to 1914. These displays and the stimulus they have given to mechanical and technical advancement in the foundry field are a direct result of the improved relations between foundrymen which now exist throughout the world—and in the creation of these better relations American foundrymen have played no small part.

* A Paper read before the American Foundrymen's Association. The Author is the Chairman A.F.A. Committee on International Relations.

The growth of international co-operation has also stimulated closer personal ties between the foundrymen of the various European nations and between those of the Old World and the New. There has been a healthy increase in travel back and forth. The culmination was reached at the International Foundrymen's Congress in Paris in 1923, which was attended by a large delegation of members of the American Foundrymen's Association, and the representatives of 11 other nations.

Taken together all this activity is resulting in a quickening of the development of the foundry industry along both business and technical lines. Without surrendering any of their nationalism the foundrymen of the different countries are influencing one another in beneficial ways. As far as we are concerned, the influence of European foundry practice on America is being strengthened, and *vice versa*.

Where the Roots Lie Buried.

In at least two directions European foundry practice has been of great service to America. It is to Europe that we are largely indebted for our craftsmanship. European foundrymen possess an all round training which it is difficult to obtain in the United States at present. Therefore it may be said that more than anything else they have brought us skill. This we have adapted and improved to suit our own conditions, but the cradle of foundry business was in north-western Europe. There were skilled moulders in Europe when America was still a wilderness. Cannon balls and a large iron gun were cast in London in 1516. One of the earliest European foundrymen, in the commercial sense, was Dud Dudley, an Englishman who obtained a patent for the manufacture of iron castings from James I in 1619—a year before the founding of the Plymouth colony.

A little more of this history is interesting to show how the roots of the American foundry industry are buried deep in European, especially British, soil. Dud Dudley was one of the first writers in the world on foundry subjects, and his book, "Metallum Martis," mentions various castings which he made for military and civilian purposes. Common iron castings, however, were not produced regularly in Europe until towards the eighteenth century. It was about 1709 that the ordinary sand mould was introduced into England as a result of the efforts of Abraham Darby, who with four partners established the Baptist Mills at Bristol. The workmen were Dutch brass founders who had learned the art of making brass castings in sand in Holland. Their first attempts with iron were failures, and considerable loss was incurred in unsuccessful experiments. Finally one night Abraham Darby, with the assistance of a young workman named John Thomas, succeeded in casting an iron pot. From that time forward iron founding grew and flourished in the British Isles, from which at an early date it was introduced to North America. At the same time there were parallel developments in France, Germany, and other continental countries, from the results of which early American foundrymen profited.

When one considers the obstacles which had to be overcome in those days, by rule of thumb methods without modern scientific aids, it can be appreciated why European foundrymen look with pride on the achievements of their forefathers. It also is evident that there is sane reasoning in their contention that methods and practices are not necessarily bad because they are old. There is virtue in the old as well as in the new. But what has resulted in Europe, which America has been fortunate in largely avoiding, is a peculiar combination of moss-grown traditions and modern ideas, the co-existence of antiquated processes and twentieth century methods. This is a product of the past and is only natural in countries which were old before the United States was discovered. It may have drawbacks, but it also means that the historically inclined European foundryman can draw inspiration from a past which fairly teems with great inventions in metallurgy and shop practice from which the whole world has benefited. But there is no reason why American foundrymen should not participate in this source of inspiration. This would enable us, along with the progressive manufacturers of castings in Europe, to create a practice in which is combined all that is best and tried in the old with those elements which are most promising and successful in the new.

Modern Progress Abroad.

Europe has not grown great merely by feeding on traditions. Her leading men, in any line of endeavour, have always been pushing ahead. Therefore in the modern theatre, American foundry practice can profit by the closer contacts we are establishing with the Old World. Great as has been our advance in research work, there are directions in which we might profitably be influenced by the progress of Europe. Foreign foundry scientists are able to show us what can be done by individuals in the field of technical investigation. In both England and France there is a spirit of individualism in research work which is healthy. Take, for instance, Professor Turner's investigations of the effect of silicon, Cook's researches into the network phosphide-cementite eutectic in cast iron, or the Fremont-Portevin method of testing as tangible examples of valuable offerings which individual European foundrymen of scientific bent have tendered to their American confrères.

The contacts established in the past few years have given American foundrymen equal opportunities in the field of shop practice. Along this line the work of Stokes on centrifugal castings might be cited. This process opens up a whole new vista of casting manufacture. We have also the benefit of the study of foundry sands made by Prof. P. G. H. Boswell while in the sphere of marine engineering, in which British foundrymen admittedly are leaders; the methods of moulding large propellers, etc., developed by men like Lambert have been of great value to American producers. On the other side of the channel a distinguished French foundryman, E. V. Ronceray, has given us the benefit of his work on how to make castings without feeding heads and risers, a suggestion of great value to shops handling large quantities of metal, the cost of which runs into thousands of dollars a day. In short, the influence of European foundry practice on the American industry instead of being negligible comes nearer to being profound. At least the foregoing indicates how advisable it is for the progressive American foundryman to keep in touch with the latest European developments.

The reverse is equally true. Now that it is in the full tide of manhood, the influence of American foundry practice on Europe is tremendous. This is creating new developments and tendencies in the Old World with which American producers would do well to keep in touch. Europe looks largely to the United States for the application of labour-saving equipment to the production of castings. There is a tendency abroad to pay attention to metallurgy rather than to shop practice, the latter being left more to the inherited skill of successive generations of moulders. This means that the foreman in Europe occupies an exceedingly important position, left, as he is in many cases, more or less to work out his own methods. In the United States the shortage of skilled labour has forced us to develop ways of doing things by machinery, in the working out of which our large markets are a big help. So we are in a position to give leads to Europe in the direction of applying machinery and the energies of technically trained men to problems of shop practice. Our position in this branch of foundry work is more or less generally acknowledged. American moulding machines are found throughout the length and breadth of Europe, while many of the locally-made machines show the influence of American design and inventive genius. Others, it is true, like the French hydraulic type, are decidedly original. In this category might be placed also the English electro-pneumatic machine. In general, however, America sets the pace. The same is more or less true of other kinds of foundry equipment.

American Methods Adopted.

Naturally in the field of automobile castings the influence of American methods is felt abroad. On both sides of the ocean the specifications of automobile engineers have become constantly more exacting while the problems in the way of moulding and coring which the foundryman is asked to

solve are growing continuously more difficult and complicated. As a result, both in Europe and in this country, only those plants equipped and organised to turn out the highest grade of grey-iron castings have been able to make a continuous success of automobile work. To meet the requirements of this new industry specialty shops have been developed in Great Britain and on the Continent to produce motor-car and motor-cycle cylinder castings largely according to American methods, except that there is a tendency to adhere to dry-sand practice. The oil-sand core, on the other hand, has been almost universally adopted. The organisation features and methods of up-to-date British automotive foundries such as those found in Smethwick and Coventry possess many features which had their origin in the United States. Near Paris there is now being built a new automobile factory which will be equipped throughout almost exclusively with American machinery and appliances, especially in the foundry. In Coventry there is an exceedingly successful piston-ring foundry, the manager of which sticks closely to what may be termed the American idea of following out one definite line of manufacture to the point of exhausting its possibilities.

The introduction of a certain American type of moulding machine is gradually transforming the practice and methods of one of the oldest and most famous foundry centres in Scotland. Bath tubs, which a skilled moulder and labourer turn out at a rate of three or four per day, are being made with the help of this machine and a gang of three semi-skilled men and a boy at the rate of four or five per hour. In addition to such activities, we have the influence of the practice of American-owned plants in Europe, such as the foundries of the International Harvester Company in Lille, France, or of the Ford Motor Company at Cork, Ireland.

American manufacturing methods are influencing European foundry practice in another direction. The writer has reference to what may be termed the American conception of quantity production. That this is somewhat different from some European ideas of what they call mass production is evident from a superficial study of the situation. If in the next ten years America can give to Europe a true conception of what quantity production really stands for, it will be a contribution of the first magnitude to the material progress of the twentieth century. The idea that quality must go hand in hand with quantity production lies at the root of this problem. The idea persists in some European quarters, especially in the foundry field in England, that modern high-speed production somehow implies a lowering of quality standards. It even is contended that these methods have all but eliminated the skilled workman and annihilated craftsmanship, without which a superior product cannot be produced. It is not always appreciated that what quantity production methods really imply is merely a change in the way in which craftsmanship is applied to the job. This aspect of the manufacturing problem seems to be grasped somewhat more readily on the Continent than in Great Britain, but a change of view is taking place on both sides of the Channel. Gradually it is becoming evident that it is not necessary to follow slow, expensive, hand production methods to produce a quantity product. Given raw materials of the proper sort coupled with methods that are right and an organisation which insures the proper maintenance of standards, both as regards raw materials and process, and the result must be a satisfactory product of uniformly high quality. It is a question not of energising but of controlling the processes of production. This is the view of America, which the writer ventures to predict will have a considerable influence on the development of European manufacturing methods, especially in the foundry field, in the next 10 or 20 years.

From all of the foregoing it is evident that there is a great interchange of information now taking place in the engineering field between the eastern and western hemispheres. The Old World is influencing the technical development of the New, and *vice-versa*. Both sides are profiting, and there is more intercourse across the seas to-day than ever before. In the foundry business, therefore, the work of the American Foundrymen's Association in foreign fields in conjunction with the Institute of British Foundrymen and the foundrymen's associations of Belgium, France, and other countries, is of the highest importance. Perhaps it can be ranked as one of the three or four most important things the Association is doing, not only on account of its present value, but due to its future possibilities as well.

What American Foundrymen's Association Has Done.

This work consists primarily in stimulating the interchange of information between the foundrymen of the world. In this direction the American Foundrymen's Association has been a pioneer. In 1920 it entered into a formal agreement with the Institute of British Foundrymen to exchange Papers dealing with important questions of foundry practice each year. The underlying idea of this arrangement is that every year the Institute of British Foundrymen will appoint one of its members to write a Paper for the A.F.A. dealing with some phase of British foundry practice which would be of use to the industry in the United States. Likewise the A.F.A. commissions one of its members every year to send the British Association a Paper covering some feature of American foundry practice that might have European application. This agreement is now in its fourth year, and the results of its working have been so satisfactory that other exchanges of Papers have taken place between the American and the French and Belgian Foundrymen's Associations, and between the latter and the British Association.

A great interchange of ideas has thus been set in motion, for the initiation of which the A.F.A. is responsible. A list of the Papers exchanged so far is detailed below. In commenting on this agreement in his annual report, W. R. Bean, President of the American Foundrymen's Association, 1920-22, said:—

"The American Foundrymen's Association recently has taken the lead among the technical societies of the country in establishing an intelligent exchange of technical information with similar foreign associations by making arrangements for an annual exchange of Papers with the leading foundrymen's associations of Europe. Beginning with the formal agreement completed in 1920 . . . the arrangement has now been enlarged to include . . . the associations (respectively) of Belgium and France."

Abroad this suggestion of the American Foundrymen's Association has met with a whole-hearted response, and the best European foundry experts have been detailed to contribute to the A.F.A. programmes. Commenting on the arrangements, the Council of the Institute of British Foundrymen stated in 1922:—

"We attach very much importance to the interchange of Papers, and hope in the future much more progress will be made in this direction."

Accompanying this exchange of Papers, and to some extent antedating it, there has been a series of visits which has contributed to the close co-operation that now prevails between European and American foundrymen. In 1919 the late Mr. A. O. Backert, at that time President of the A.F.A., paid an official visit to England and paved the way for much that has taken place since that time. In 1922 Mr. Oliver Stubbs, President, and the late Mr. Tom Firth, Past-President, of the Institute of British Foundrymen, visited the United States. They were followed in 1923 by Mons. Emile Ramas, who came as President of the Association Technique de Fonderie de France. There have been numerous other visitors since the war on both sides. Al this has contributed to the establishment of personal contacts of a more lasting and intimate character than have ever before existed between European and American foundrymen.

In 1923 a party of about 40 members of the American Foundrymen's Association went to Europe in a body and travelled through Great Britain, France, and Belgium, where they were officially entertained. It is doubtful if any other body of American engineers or professional men ever received such courtesies from their confrères in so many different European countries. This trip was an object lesson in understanding

between nations along industrial lines, and in the importance of international contacts between representative business men. It culminated, as previously mentioned, in the International Foundrymen's Congress in Paris, which was organised by the French Association, and in which the representatives of an even dozen countries participated. At the opening session the platform was occupied by the heads of the foundrymen's organisations of six great countries, France, Belgium, Czecho-Slovakia, Italy, Great Britain and the United States. The general secretaries of four foundrymen's associations, the British, French, Belgium and American, also were present. It is doubtful if there has ever been a more representative world gathering of men engaged in engineering work. As a result of this congress an important international committee has been set up to try and work out a generally acceptable method of testing cast iron. The Paris Convention was indeed a great occasion in the evolution of the foundry industry, and a foretaste of what may be expected from the second International Congress which is to be held in Detroit in the autumn of 1926.

In concluding this Paper, in which an effort has been made to sketch briefly the growth of international understanding among foundrymen and to indicate what it means to the industry at home and abroad, the writer feels he should return to the sentiments expressed by Mr. Oliver Stubbs, quoted above, as expressing the larger aims that should underlie any international movement among business and professional men. As Mr. Stubbs points out, what we are really working for is the peace of the world. If this be idealism, let it stand. Surely there can be no less worthy object. We learned from the last war, if anything, that industry loses more than it can ever gain from a conflict in arms. So even on their lowest terms, the efforts which American and European foundrymen are making to understand each other, and to promote peace, concord and technical advancement, are fully justified, while taken at their highest, they represent a real contribution to human progress.

Papers Exchanged with European Associations.

Papers Contributed by Institute of British Foundrymen to American Foundrymen's Association.

1922.—"American *versus* British Cast Iron." By F. J. Cook, Past-President, I.B.F.

1923.—"British Foundry Practice." By Dr. Percy Longmuir, Past-President, I.B.F.

1924.—"British Bell Founding Methods." By Wesley Lambert, member of Council, I.B.F., and George Hall.

Papers Contributed by French Foundrymen's Association to American Foundrymen's Association.

1922.—"Destruction and Reconstruction of French Foundries." A Memoir submitted by the Association Technique de Fonderie de France.

1922.—"European *versus* American Moulding Machines." By E. V. Ronceray, Treasurer, A.T.F.

1922.—"A New French Electric Furnace." By R. Sylvany.

1922.—"A European View of the Malleable Problem." By T. Levoz.

1923.—"Aluminium and Light Alloys." By M. de Fleury.

1923.—Address by Emil Ramas, President, A.T.F.

Papers Contributed by Belgian Foundrymen's Association to American Foundrymen's Association.

1922.—"Making Typewriter Frames in a Belgian Foundry." By Joseph Leonard, Past-President, A.T.F. de Belgique.

Papers Contributed by American Foundrymen's Association to Institute of British Foundrymen.

1921.—"The Basic Hearth Electrical Furnace and Some Problems of Cast Iron." By George K. Elliott, Cincinnati.

1922.—"American Methods of Manufacturing Malleable Iron Castings." By Prof. Enrique Touceda, consultant, American Malleable Castings Association.

1923.—"American Methods of Producing Steel Castings." By R. A. Bull, Past-President, A.F.A.

1924.—"The Production of Castings in Permanent Moulds." By Dr. Robert J. Anderson, U.S. Bureau of Mines, and Edward M. Boyd.

1925.—"Present Status of the Laboratory Investigation of Sands." By Dr. H. Ries.

Papers Contributed by American Foundrymen's Association to French Foundrymen's Association.

1922.—"Malleable Iron Castings." By Prof. A. E. White and H. E. Gladhill.

1923.—"The Bonding Substance of Moulding Sands." By H. B. Hanley, Rochester, N.Y.

1923.—"Testing Cast Iron." By Dr. Richard Moldenke.

Effect of Oxy-Acetylene Cutting on Ductility of Steel.

It has been a common belief of some engineers that the ductility of steel is injured by cutting with the oxy-acetylene flame, and the writer knows of a case where a highway authority barred the oxy-acetylene cutting of structural steel for roadway bridges. This attitude led to a series of investigations on the relative effects of hacksaw cutting, milling, flame cutting, shearing and friction sawing upon the metal adjacent to the cut face, and the tests indicate that flame cutting does not injure the metal, since both the strength and ductility of the flame-cut surfaces were equal to those of milled and hacksawed surfaces.

In the tests square bars were cut from ⅜-in. structural steel plates, either one or both edges being cut by the method under test. They were then bent between bearing blocks spaced about 1 in. apart by a plunger with the end rounded to a semi-circle of ¾ in. diameter. In all cases the face cut by the method under test was on the outside of the bend. The table gives the

Table showing Results of Tests on Bending Structural Steel after Cutting by various methods.

Material.	Cutting Method.	Maximum load required in bending lb.	Maximum angle of bend degrees.
Steel plate ..	Machined ..	1,580	180
	Cut with flame ..	1,670	180
	Cut with flame, ⅛ in. of flame-cut edge then machined off ..	1,560	180
	Sheared	1,250	37
I-beam web	Machined	1,450	180
	Cut with flame ..	1,625	180
Angle bar (A)	Machined ..	2,510	72
	Cut with friction saw	1,840	18
Angle bar (B)	Machined ..	2,230	180
	Cut with friction saw	1,500	29

maximum load required in the bending and the angle of bend at which cracking occurred. Where 180 deg. is given the full bend was made without cracking.

On comparing the first four items in the table it is seen that three were fully bent without a fracture, and the fourth specimen, which had a sheared edge, cracked at a small angle, and showed low strength. Of the first three, the first bar was cut by hacksaw, the second with an oxy-acetylene flame, and the third, after being cut oversize by the flame, was milled off ⅛ in. On comparison, the second and third specimens reveal a slight hardening effect of the flame, which is indicated by the strength figures, while the angle of bend shows that the ductility was not affected. When the flame-cut face was milled the hardened metal was removed.

Tests made on bars cut from the web of an I-beam again showed satisfactory comparison with the flame-cut and machined surfaces. In four tests made on bars cut from steel angle the comparison of the effects of hacksaw and friction saw showed a marked reduction in ductility resulting from cutting with a friction saw.

Trade Talk.

THE IMPORTS of foreign iron ore at the Senhouse dock at Maryport last week amounted to 4,000 tons.

THE NORTH BRITISH LOCOMOTIVE COMPANY has secured an order for 15 locomotives for the Southern Railway.

CAMMELL, LAIRD & COMPANY, LIMITED, have secured an order for 40 motor-cars and 120 trailer cars from the Bombay, Baroda and Central India Railway, which is electrifying a portion of its system.

IT IS REPORTED that the German electrical firm of Siemens Schuckert has signed a contract with the Irish Free State Government, undertaking to construct hydro-electric works on the River Shannon which are intended to supply light and power to a large area of the Free State.

TENDERING FOR THE SUPPLY of steel wire haulage ropes for the Glasgow Corporation Tramways Committee, five firms all quoted the price of £6,544 13s. 9d. After discussion, the committee recommended that in future the manager should invite foreign offers for such supplies, and that the attention of the Government be directed to the position in regard to the supply of wire rope as disclosed by the fact that the quotations were alike in every case.

THE FACT THAT the private shipyards have been asked by the Admiralty to tender for the machinery and equipment of the two cruisers which are to be laid down this year, but have not been asked to tender for the hulls, is taken as an indirect indication that the hulls are to be built in the Royal Dockyards. This is said to be a disappointment to the private yards, which are able to build quicker and cheaper—which is now so important a consideration—than the Royal yards.

A NEW SYSTEM of steel houses, designed by a local builder, Mr. William Crane, for the Housing Committee of the Nottingham City Council, is to be tried at Wollaton Park. The houses consist of a steel framework filled with concrete slabs. The interior walls are made of plaster slabs, and no steel is visible from the outside. The houses, it is claimed, can be built cheaply by mass production, as the processes are mainly repetition work, and the time taken to build one house is about eleven days.

HOUSES WITH THE OUTER WALLS constructed of standard cast-iron plates have been approved of by the Ministry of Health. They are erected on a system devised by Newton Chambers & Company. These Thorncliffe-type cast-iron houses are eligible for the subsidy under the Housing Acts of 1923 and 1924. The outer walls are rough cast with a heavy layer of concrete. A patented method of jointing is employed between the flanges. The division walls and chimney breasts are built of brickwork bonded into the cast-iron shell. The internal walls to the ground-floor rooms and bedrooms are formed of lath and plaster covered with asbestos cement sheets. A specimen pair of these houses have been erected in 30 working hours in Sheffield.

SIR GEO. B. HUNTER (chairman of Messrs. Swan, Hunter & Wigham Richardson, Limited) has written a booklet in which he exposes the futility of high wages and low production. The writer remarks that the mistaken policy of British trade unions, and acquiescence in the policy of high wages, short hours, and low production has prevented and is preventing the return of industrial prosperity and the return to employment of more than a million of our workers. That policy, it must be said, with all goodwill to the miners and all other workers, has been tried for six years, and is an utter failure. It was premature, and a mistake, to adopt the eight hours days after the Armistice. That reduction has been a failure. It was a far greater mistake to adopt the seven hours day in coal mines. Other nations have not followed our example, and will not do so for years to come. Meantime our industries are being ruined. It is not possible to have nine hours' pay for seven hours' work. Yet that is what the miners are asking, whether they realise it or not. While they decline to work more than seven hours a day, and ten or eleven days per fortnight, surely they have no right to complain of low wages. They are trying to get out of the industry more than they put in. Their competitors are working longer hours for much lower wages. That is why 300,000 miners have been unemployed, and shipbuilders, engineers, steelworkers, textile workers in hundreds of thousands are unemployed. Both our home industries and our export trades require coal at 10s. per ton. It is a safe prediction that until we all work our hardest (and until we have cheaper coal and railway carriage) there will be no permanent return of our industrial prosperity, and the workmen in all our trades will suffer more and more from unemployment. The sheltered industries for a time may not suffer, but in the end they will.

Contracts Open.

Darlington, September 10.—Iron and steel for six months ending March 31, 1926, for the Corporation. The Borough Surveyor and Waterworks Engineer, Town Hall, Darlington.

Skipton, August 31.—540 yards of 6-in. and 400 yards of 3-in. cast-iron pipes (socket and spigot), for the Skipton U.D.C. Mr. J. H. Woodward, Engineer and Manager, Gasworks, Skipton.

Wincanton, September 7.—Supply and erection of pumping plant, for the Wincanton R.D.C. A. P. I. Cotterell & Son, engineers, 17, Old Queen Street, Westminster, London, S.W.1. (Fee £2 2s., returnable.)

Chell, Stoke-on-Trent, August 31.—Electrically-driven pumping plant at the Turnhurst Road Institution, Chell, for the Guardians of Stoke and Wolstanton Union. Mr. T. Wood, clerk, Union Offices, Stoke-on-Trent.

Sandwich, August 31.—Providing and laying about 620 yards lineal of 6-in. cast-iron water main with sluice valves, hydrants, etc., for the Town Council. Mr. R. Saunders, borough surveyor, The Barbican, Sandwich.

Antwerp, September 10.—One steel motor boat, to be driven by a four-cylinder oil engine, for Antwerp Municipality. The Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. (Reference A.X. 2317.) (Fee 5.000 fcs.)

Johannesburg, September 17.—Supply and delivery of one 100-ton combination railway wagon weighbridge, for the South African Railways and Harbours. The Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. (Reference A.X. 2324.)

Constantinople, Turkey, September 8.—Lathes, milling machine, shearing machine press, etc., also metal smelting furnaces, for the Commission d'Achats des Postes et Telegraphes, Stamboul, Constantinople. The Department of Overseas Trade, 35, Old Queen Street, S.W.1. (reference A.K.2328).

Personal.

MR. S. HARRISON SMITH, formerly connected with the Locomotive Department of Messrs. Armstrong, Whitworth & Company, at Scotswood, was the recipient of a presentation recently on his leaving to take up consulting work in Newcastle-on-Tyne.

PROFESSOR PISEK, the president of the Czecko-Slovakian Foundrymen's Association, is at present on a visit to this country. Correspondence for the Professor may be addressed to the office of the FOUNDRY TRADE JOURNAL.

Wills.

DAVY, DAVID (57), of Princes Hotel, Hove, late of Messrs. Davy Brothers, Park Iron Works, Sheffield £8,461

BEST, R. H., of Hamstead Road, Handsworth, Birmingham, chairman of Best & Lloyd, Limited, manufacturers of gas and electric light fittings £85,280

Obituary.

MR. ALBERT ROPER, formerly head of the firm of D. Roper & Company, nail manufacturers, recently died at the age of 75 years.

MR. ALFRED J. SHORT (President of the Birmingham Association of Mechanical Engineers) died recently, aged 57 years. He had been a member of the Association since 1900.

HERR RICHARD LINDENBERG, the proprietor of Messrs. Rich. Lindenberg, of Remscheid-Hasten, Germany, died on July 22. He was a pioneer of the electric steel manufacture in Germany.

COLONEL SIR ADAM BECK, former member of the Legislative Assembly of Ontario and Chairman of the Hydro-Electric Power Commission, died recently in London at the age of 68. He was responsible for the organisation of a power service under municipal control which now supplies energy generated at Niagara to 239 municipalities, 65 townships and rural districts, and 51 industrial companies. The aggregate peak-load capacity is nearly 750,000 h.p., and the total annual output of energy 2,300,447,000 kw.-hrs.

WE UNDERSTAND that the business of the "Cantie" Switch Company, Limited, Leighton Street, Carlton Road, Nottingham, has recently been purchased by Messrs. Brookhirst Switchgear, Limited, of Chester, but will continue to be carried on under the present name and from the present address. It is being arranged, however, that the branch offices and agents of Brookhirst Switchgear, Limited, shall represent this company.

IRON AND STEEL MARKETS.

Pig-iron.

MIDDLESBROUGH.—The Cleveland iron market, having been partially closed last week on account of the local race holiday, was re-opened on Tuesday, but with only unimportant business reported, buyers pursuing a waiting policy in view of the prospect of cheaper fuel in the immediate future, which should have a further downward effect upon prices of pig-iron. Such a movement would, doubtless, stimulate both the home and export trade, the latter especially feeling the adverse effect of Continental competition iron from Belgium and France, being quoted at least 8s. per ton lower, f.o.b. Antwerp, than Cleveland makes, f.o.b. Tees. Strenuous efforts are consequently being made by Cleveland furnaces to cope with the situation, and prices have further relapsed. No. 3 G.M.B. having dropped to 69s. per ton, and probably 69s. would be taken for any good order. No. 1 is now no more than 73s. per ton, No. 4 foundry about 68s., and No. 4 forge in the region of 67s. 6d. per ton.

The Tees-side hematite market presents a rather firmer appearance, owing to a rather better home demand and to the depletion of stocks at various works which have, at different times during the current year, discontinued production. With regard to prices, there has been no change in quotations, East Coast mixed numbers still standing at 75s. 6d. per ton, with the No. 1 quality 76s. per ton. On the North-West Coast, Bessemer mixed numbers are quoted nominally £4 5s. c.i.f. Welsh ports, £4 8s. 6d. per-ton-delivered at Glasgow, £4 11s. 6d. per ton delivered at Sheffield, and £4 15s. per ton delivered at Birmingham.

LANCASHIRE.—The local pig-iron markets continue quiet, with business almost entirely confined to immediate necessities of consumers. Prices, also, are irregular, some sellers of No. 3 foundry iron for local delivery quoting 77s., but it is reported that No. 3 iron has been offered in Manchester at 75s. per ton. It is generally understood that Lincolnshire iron can now be bought in Lancashire at the lowest price, although there is some Derbyshire iron, which is obtainable at something near the lowest price.

THE MIDLANDS.—The markets for foundry pig in this area may be best described as inactive to almost stagnation point, the lower prices recently quoted, which are still maintained, not yet having had any practical result. The ironfounders are not convinced that prices must be getting very near the bottom, which the furnaces allege, and buying from hand-to-mouth is more or less the rule at the present time. With regard to prices, latest quotations rule about 67s. 6d., f.o.t., for Derbyshire No. 3 foundry, and 62s. 6d. for No. 3 Northants. At the moment these prices appear firm.

SCOTLAND.—Business in this area continues much the same as last reported, but, unfortunately, there is still no improvement in the demand, consumers being so short of work that they are only buying for their immediate requirements. The makers' price for No. 3 Scotch foundry iron is unchanged at 81s. per ton at the furnaces, but merchants are prepared to shade this price, even for small lots.

Finished Iron.

Work in the manufacturing departments of the industry is at present mostly restricted to half-time capacity, makers of marked bars being the best off for orders, with specifications in hand for some weeks ahead. Makers of the cheaper iron are working very fitfully, as there is nothing near sufficient business about to keep all of them busy. What orders there are about are very keenly competed for, and although the Association figure for crown iron is £12 7s. 6d. per ton, slightly lower prices are having to be taken to meet outside competition. There is still less business available for the makers of bolt and fencing irons, as the majority of orders for this class of iron are having to go abroad because of the disparity in price between the Belgian houses and local producers. The Staffordshire price for this grade is £11 7s. 6d. per ton, but the foreign product is quoted at £6 15s. to £7 per ton. Therefore, force of circumstances makes it impossible for the local ironmasters to receive but a very small proportion of work available.

Steel.

In the Sheffield market the buying of billets, acid qualities in particular, is slightly better. Local production of open-hearth steel is about a third of capacity. There is little forward buying, a remark which also applies to basic steel, which is just now being produced in excess of requirements. In the tinplate market rumour has been current that a movement is on foot to revive the stabilisation scheme in some form or other. It remains to be seen whether an agreement satisfactory to all parties can be reached. Meanwhile several buyers have covered their requirements for the next two or three months. Makers' ideas of prices are hardening, and from 19s. to 19s. 3d. is now quoted for I.C. 14 by 20.

Scrap.

Very little improvement can be discovered in the various markets for scrap metals, with the tendency of prices to lower levels still unchecked. At Manchester buyers now think that 70s. per ton delivered is ample to give for good cast scrap, but dealers are still quoting 72s. 6d. Textile or "loom" scrap is still not plentiful, and a special price can be obtained for it; but this quality is easier than it was, and might, no doubt, be bought at 80s. per ton, or a little less. In Scotland machinery cast-iron scrap is still very easy, and odd lots are changing hands at 72s. 6d. to 75s. per ton, but the demand is exceptionally poor. Ordinary cast-iron scrap suitable for foundries can be picked up at 68s. 6d. to 70s. per ton. Light cast iron and firebars still remain unchanged around 55s. to 56s. 3d. per ton. The above prices are all per ton, delivered f.o.t. consumers' works.

Metals.

Copper.—Movements in standard copper during the past week have disclosed consistently steady conditions, with mostly an upward tendency in values, due in a measure to revived strength in American advices. Following a period of active New York buying temporarily checked, it is confidently anticipated on this side that the market is now in a sounder position, and that values are likely to be maintained at near about present levels for some time forward. Current quotations :—*Cash* : Thursday, £63; Friday, £63 5s.; Monday, £63 2s. 6d.; Tuesday, £52 10s.; Wednesday, £62 5s.

Three Months : Thursday, £63 17s. 6d.; Friday, £64 2s. 6d.; Monday, £64; Tuesday, £63 10s.; Wednesday, £63 5s.

Tin.—The market during the past week has developed remarkable weakness, with daily recessions in price, but later has acquired stronger tendency. The cause of the decline was heavy liquidation, which in some quarters is attributed to the clearing up of the derelict German holdings. America has bought moderately, and the Continent also continues to buy. The Straits have sold daily, but Batavia is still much above parity. A feature recently has been better buying by South Wales. Current quotations :—*Cash* : Thursday, £256 17s. 6d.; Friday, £257 15s.; Monday, £257; Tuesday, £256 15s.; Wednesday, £256 5s.

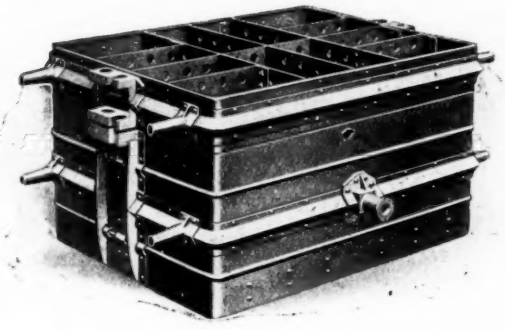
Three Months : Thursday, £259 12s. 6d.; Friday, £260 7s. 6d.; Monday, £260 2s. 6d.; Tuesday, £259 15s.; Wednesday, £259 5s.

Spelter.—Values in this section having very substantially advanced recently, it was not surprising that some reaction should have taken place, and the more so because the whole of the situation respecting metals has of late suffered from a moderate wave of depression. The actual situation has undergone no material change, and, as the market has been well supported, the recession in values at no time amounted to very much. Current quotations :—*Ordinary* : Thursday, £36 18s. 9d.; Friday, £37 2s. 6d.; Monday, £37 1s. 3d.; Tuesday, £36 17s. 6d.; Wednesday, £36 16s. 3d.

Lead.—The market for soft foreign pig has been very irregular, with a slight decline in forward prices. The previous sharp advance, which was due largely to "bear" covering, the extraordinary demand from Germany, and speculative purchases, had rendered the market, although sound enough, in a somewhat vulnerable position, and prices were, therefore, more readily affected by the slight reversal in sentiment. Current quotations :—*Soft foreign (prompt)* : Thursday, £38 17s. 6d.; Friday, £39; Monday, £39 5s.; Tuesday, £39 7s. 6d.; Wednesday, £39 17s. 6d.

THE CZECHO-SLOVAKIAN FOUNDRYMEN'S ASSOCIATION are holding their annual conference from September 26 to 28 at Pilsen (Plzen). Prof. Pisek, the President, will be glad to welcome any members of the Institute of British Foundrymen who care to participate. Three papers are to be given in French, three in German and five in Czech.

HAVE YOU A SIMILAR JOB?



STERLING BOXES WILL HELP YOU TO GET BETTER RESULTS

Several hundreds of these Boxes have been supplied for making Morris Motor Cylinder Block Castings. Sterling throughout—they are producing extremely accurate castings against rigid inspection and making them better, quicker and cheaper than ever before.

Sterling Foundry Specialties, Ltd.
BEDFORD

London Office: 13, Victoria Street, S.W.1.

SIEMENS' STEEL PROCESS

BOILER, SHIP and BRIDGE PLATES, etc. ANGLES and all forms of Sectional Bars. TYRES and AXLES to all requirements. CASTINGS of all kinds and of Largest Sizes. FORGINGS of every description. BILLETS, BLOOMS, RAILS.

SPECIAL STEEL FOR CONSTRUCTIVE PURPOSES.

The STEEL COMPANY OF SCOTLAND, Ltd.

Head Office: 23, ROYAL EXCHANGE SQUARE, GLASGOW.
Works: HALLSIDE, NEWTON and BLOCHAIRN, GLASGOW.
CONTRACTORS TO HOME, COLONIAL AND FOREIGN GOVERNMENTS.

Established 1872. *Telegraphic Address: "Steel, Glasgow."*

GANISTER, CUPOLA BLOCKS, FIRE BRICKS, FIRE CLAY.

Silica Bricks, Tuyeres, Stoppers, Nozzles, &c.

STEEL MOULDERS' COMPOSITION, SILICA CEMENT.

J. GRAYSON LOWOOD & Co., Ltd.

DEEPCAR, nr. SHEFFIELD.

Telegrams: "LOWOOD, DEEPCAR."

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	62	5	0
Three months	63	5	0
Electrolytic	68	2	6
Tough	65	15	0
Best selected ..	66	0	0
Sheets	93	0	0
India	82	10	0
Wire bars ..	69	5	0
Do. Sept.–Oct.	68	15	0
Do. Sept.–Oct.	68	15	0
Ingot bars ..	68	15	0
H.C. wire rods	73	5	0
Off. av. cash, July	61	10	7 4/13
Do., 3 mnths. July	62	10	5 9/13
Do. Sttlmnt, July	61	10	6 12/13
Do., Electro, July	66	0	0
Do., B.S., July	64	0	10
Aver. spot price copper, July	61	10	6½
Do., wire bars, July	66	5	0
Solid drawn tubes			13¼d.
Brazed tubes ..			13½d.
Wire			10d.

BRASS.

Solid drawn tubes	12d.
Brazed tubes ..	13½d.
Rods, drawn ..	10¾d.
Rods, extd. or rlld.	7½d.
Sheets to 10 w.g.	10¾d.
Wire	10½d.
Rolled metal ..	9¾d.
Yellow metal rods	7½d.
Do. 4 x 4 Squares	8d.
Do. 4 x 3 Sheets	8½d.

TIN.

	£	s.	d.
Standard cash	256	5	0
Three months ..	259	5	0
English ..	257	0	0
Bars	259	0	0
Straits	262	15	0
Australian ..	260	5	0
Eastern ..	265	0	0
Banca	262	15	0
Off. aver. cash, July	258	10	6 12/13
Do., 3 mths., July	260	17	6
Do., Sttlmnt. July	258	10	2 14/13
Aver. spot., July	258	10	2½

SPELTER.

Ordinary ..	36	16	3
Remelted ..	36	10	0
Hard	30	10	0
Electro 99.9 ..	41	10	0
English ..	37	7	6
India	31	10	0
Zinc dust ..	43	0	0
Zinc ashes ..	14	10	0
Off. aver., July	34	14	0 27/40
Aver., spot, July	34	17	10½

LEAD.

Soft foreign ppt.	39	17	6
English ..	41	0	0
Off. average, July	34	7	1 5/40
Average spot, July	34	13	11½

ZINC SHEETS, &c.

Zinc sheets, English	42	10	0
Do. V.M. ex whf.	42	10	0
Dutch			—
Rods	48	0	0
Boiler plates ..	41	10	0
Battery plates	42	0	0

ANTIMONY.

Special brands, Eng.	74	10	0
Chinese ..	64	10	0
Crude	53	0	0

QUICKSILVER.

Quicksilver ..	13	10	0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro silicon
45/50% .. 12 17 6
75% 21 10 0
Ferro-vanadium—
35/40% 16 6 to 17/– lb. va
Ferro-molybdenum—
70/75% c. free 7/– lb.
Ferro-titanium—
23/25% carbonless 1/–lb.
Ferro-phosphorus, 20/25%, £22 0 0
Ferro-tungsten—
80/85%, c.fr. 1/7½ to 1/8 lb.
Tungsten metal powder—
98/99% 1/10½ to 1/11 lb.
Ferro-chrome—
4/6% car. .. £23 10 0
6/8% car. .. £23 0 0
8/10% car. .. £22 10 0
Ferro-chrome—
Max. 2% car. £42 10 0
Max. 1% car. £52 0 0
Max. 0.70% car. £56 10 0
70%, carbonless 1/5 lb.
Nickel—99%, cubes or pellets £170 to £175
Cobalt metal—98/99% 10/3 lb.
Aluminium 98/99% £118
Metallic Chromium—
96/98% .. 3/9 lb.
Ferro-manganese (net)—
76/80%, loose £15 10 0
76/80%, packed £16 10 0
76/80%, export £15 0 0
Metallic manganese—
94/96%, carbonless 2/–lb.
Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

	s.	d.
Finished bars, 14% tungsten ..	2	6
Finished bars, 18% tungsten ..	3	0

Per lb. net, d/d buyers' works.
Extras—
Rounds and squares 3 in. and over .. 4d. lb.
Rounds and squares under ½ in. to ¼ in. 3d. lb.
Do. under ¼ in. to 7/16 in. .. .. 1/– lb.
Flats, ½ in. × ¼ in. to under 1 in. × ¾ in. 3d. lb.
Do. under ½ in. × ¼ in. 1/–lb.
Bevels of approved sizes and sections 6d. lb.
Bars cut to length 10% extra

Scrap from high-speed tool steel—
Scrap pieces .. 3d.
Turnings and swarf 1d.
Per lb. net, d/d steel makers' works.

SCRAP.

South Wales—£ s. d.	£	s.	d.
Hvy. steel	3	5	0
Bundled steel & shrngs. 3 0 0 to	3	3	6
Mixed iron & steel 3 0 0 to	3	2	6
Heavy cast iron 3 1 6 to	3	3	6
Good machinery for foundries 3 10 0 to	3	15	0

Cleveland—			
Heavy steel ..	2	17	6
Steel turnings ..	2	4	6
Cast-iron borings	2	0	0
Heavy forge ..	4	0	0
Bushelled scrap	3	5	0
Cast-iron scrap	3	11	0

Lancashire—			
Cast-iron scrap..	3	12	6
Heavy wrought 3 10 0 to	3	12	6
Steel turnings ..	2	5	0

London — Merchants' buying prices delivered yard.

Copper (clean) ..	53	0	0
Brass (clean) ..	40	0	0
Lead (less usual draft)	33	0	0
Tea lead ..	29	0	0
Zinc	24	0	0
New aluminium cuttings ..	95	0	0
Braziery copper	48	0	0
Gunmetal ..	48	0	0
Hollow pewter ..	180	0	0
Shaped black pewter	130	0	0

PIG-IRON.

(*f.o.t. unless otherwise stated*).

N.E. Coast—	
Foundry No. 1 ..	73/–
Foundry No. 3 ..	69/–
Foundry No. 4 ..	68/–
Forge No. 4 ..	67/6
Hematite No. 1 ..	76/–
Hematite M/Nos. ..	75/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	88/6
,, d/d Birm. ..	95/–
Midlands—	
Staffs. common* ..	102/–
,, No. 4 forge ..	67/6
,, No. 3 foundry	71/3
Shrops. basic ..	75/–
,, Cold blast, ord.*	190/–
,, ,, roll iron*	195/–
* d/d Birmingham.	
Northants forge ..	57/6
,, fdry No. 3 ..	62/6
Derbyshire forge ..	62/6
,, fdry No. 3 ..	67/6
,, basic	72/6
Scotland—	
Foundry No. 1 ..	86/–
,, No. 3 ..	81/–
Hem. M/Nos. ..	82/6
Sheffield (d/d district)—	
Derby forge ..	66/9
,, fdry. No. 3 ..	71/6
Lincs. forge ..	68 –
,, fdry. No 3 ..	72/–
E.C. hematite ..	85/6
W.C. hematite ..	91/6
Lincs. (at furnaces)—	
Forge No. 4 ..	63/–
Foundry No. 3 ..	66 –
Basic	66 –
Lancashire (d/d eq. Man.)—	
Derby forge ..	70/6
,, fdry. No. 3 ..	75/–
Northants foundry No. 3 ..	75/6
Dalzell, No. 3 ..	111/6
Summerlee, No. 3 ..	98/6
Glengarnock, No. 3	98/6
Gartsherrie, No. 3 ..	98/6
Monkland, No. 3 ..	98/6
Coltness, No. 3 ..	98/6
Shotts, No. 3 ..	98/6

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£ s. d.	£	s.	d.
Bars (cr.)	11 12 6 to 12	10	0	
Angles	12	7	6	
Tees to 3 united ins	13	2	6	
Nut and bolt	11	15	0	
Hoops 14 0 0 to	15	0	0	
Marked bars (Staffs.) f.o.t...	14	10	0	
Gas strip ..	13	0	0	
Bolts and nuts, ¾ in. × 4 in. ..	16	15	0	

Steel—			
Ship plates 8 10 0 to	9	0	0
Boiler plts. £12 10 to	13	0	0
Chequer plts. £ 9 15 to	10	5	0
Angles £8 0 0 to	8	7	6
Tees £9 0 0 to	9	7	6
Channels £7 7 6 to	7	17	6
Joists £8 0 0 to	8	7	6
Rounds and Squares 3in. to 5½in. ..	9	5	0
Rounds under 3 in. to ¾ in... ..	9	0	0
Flats, over 5 in. wide and up ..	9	15	0
Flats, 5in. to 1½in.	8	15	0
Rails, heavy ..	8	10	0
Fishplates ..	12	10	0
Hoops (Staffs.) £11 0 0 to	11	10	0
Black sheets, 24g.	11	10	0
Galv. cor. sheets, 24g.	16	2	6
Galv. fencing wire 8g. plain ..	14	0	0
Billets, soft 6 10 0 to	7	15	0
Billets, hard ..	9	0	0
Sheet bars 6 12 6 to	6	15	0
Tin bars d/d 6 12 6 to	6	15	0

PHOSPHOR BRONZE.

	Per lb.	basis.
Strip	1	3
Sheet to w.g. ..	1	3½
Wire	1	3½
Rods	1	3
Tubes	1	8
Castings	1	2

Delivery 3 cwt. free.
10% phos. cop. £40 above B.S.
15% phos. cop. £50 above B.S
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	9d. to 1/3
Rolled—	
To 9 in. wide	1/3 to 1/9
To 12 in. wide	1/3½ to 1/9½
To 15 in. wide	1/3½ to 1/9½
To 18 in. wide	1/4 to 1/10
To 21 in. wide	1/4½ to 1/10½
To 25 in. wide	1/5 to 1/11
Ingots for spoons and forks	9d. to 1/5½
Ingots rolled to spoon size	1/– to 1/8½

Wire round—
3/0 to 10 G. .. 1/6½ to 2/1½
with extras according to gauge.

AMERICAN IRON & STEEL.

At Pittsburgh unless otherwise stated.	Dols.
No. 2X foundry, Phila.	21.50
No. 2 foundry, Valley	20.26
No. 2 foundry, Birm.	18.00
Basic	19.76
Bessemer	20.76
Malleable	20.26
Grey forge	19.76
Ferro-mang. 80% d/d	115.00
Bess. rails, h'y, at mill	43.00
O.-h. rails, h'y at mill	43.00
Bess. billets	35.00
O.-h. billets	35.00
O.-h. sheet bars ..	35.00
Wire rods	45.00
	Cents.
Iron bars, Phila. ..	2.17
Steel bars	2.00
Tank plates	1.90
Beams, etc.	2.00
Skelp, grooved steel ..	1.90
Skelp, sheared steel ..	1.90
Steel hoops	2.40
Sheets, black, No. 28 ..	3.15
Sheets, galv., No. 28 ..	4.20
Sheets, blue an'l'd, 9 & 10	2.30
Wire nails	2.65
Plain wire	2.50
Barbed wire, galv. ..	3.35
Tinplate, 100 lb. box ..	5.50

COKE (at ovens).

Welsh foundry ..	37/6
,, furnace	27/6
Durham & North.	
,, foundry ..	35/–
,, furnace ..	16/–
Other Districts, foundry	35/–
,, ,, furnace (Basis)	13/6

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. Cokes,	20 × 14, box	19/3½
,,	28 × 20, ,,	38/9
,,	20 × 10, ,,	27/9
,,	18¾ × 14, ,,	20/1½
C.W.	20 × 14, ,,	17/7½
,,	28 × 20, ,,	34/9
,,	20 × 10, ,,	24/3
,,	18¾ × 14, ,,	17/10½

Terneplates 28 × 20, 35/6 per box basis f.o.b.

SWEDISH IRON.

Bars, hammered	£19/0 to £20/0
Rolled Ord.	£16/0/0 to £16/10/0
Nail rods	16 5 0 to £16 15 0
Keg. steel nom.	£33 to £35
Faggot steel nom.	£22 to £25
Blooms, according to quality	£10 to £14

Pig-iron £6 15 0 to £7 0 0 all f.o.b. Gothenburg.

TUBES.
Up to and incl. 6 in.
Gas .. 55% } Tube prices
Water .. 50% } are
Steam .. 45% } now free.

DAILY FLUCTUATIONS.

Standard Copper (Cash).

	£	s.	d.		
Aug. 20	63	0	0	inc.	2/6
,, 21	63	5	0	,,	5/-
,, 24	63	2	6	dec.	2/6
,, 25	62	10	0	,,	12/6
,, 26	62	5	0	,,	5/-

Electrolytic Copper.

	£	s.	d.		
Aug. 20	69	0	0	inc.	5/-
,, 21	69	5	0	,,	5/-
,, 24	69	5	0	No change	
,, 25	68	15	0	dec.	10/-
,, 26	68	2	6	,,	12/6

Standard Tin (cash).

	£	s.	d.		
Aug. 20	256	17	6	No change	
,, 21	257	15	0	inc.	17/6
,, 24	257	0	0	dec.	15/-
,, 25	256	15	0	,,	5/-
,, 26	256	5	0	,,	10/-

Tin (English ingots).

	£	s.	d.		
Aug. 20	257	0	0	No change	
,, 21	258	0	0	inc.	20/-
,, 24	257	5	0	dec.	15/-
,, 25	257	0	0	,,	5/-
,, 26	257	0	0	No change	

Zinc Sheets (English).

	£	s.	d.		
Aug. 20	42	10	0	inc.	10/-
,, 21	42	10	0	No change	
,, 24	42	10	0	,,	,,
,, 25	42	10	0	,,	,,
,, 26	42	10	0	,,	,,

Spelter (ordinary).

	£	s.	d.		
Aug. 20	36	18	6	inc.	2/6
,, 21	37	2	6	,,	3/9
,, 24	37	1	3	dec.	1/3
,, 25	36	17	6	,,	3/9
,, 26	36	16	3	,,	1/3

Lead (English).

	£	s.	d.		
Aug. 20	40	0	0	inc.	10/-
,, 21	40	0	0	No change	
,, 24	40	5	0	inc.	5/-
,, 25	40	10	0	,,	5/-
,, 26	41	0	0	,,	10/-

Germany.—Exports from Germany and Luxemburg.

Year.	Ingots, blooms, billets, etc.	Rails.	Sleepers, etc.	Wheels, axles, tyres, etc.	Merchant iron and steel.	Sheets and plates.	Tinplates.	Total iron and steel, including unenumerated.
	Metric tons.	Metric tons.	Metric tons.	Metric tons.	Metric tons.	Metric tons.	Met. tons	Metric tons.
1887 ..	40,135	174,226	21,553	20,447	250,632	57,992	248	565,233
1888 ..	22,293	114,946	23,254	20,808	235,429	67,805	377	485,002
1889 ..	20,808	110,949	26,042	26,030	218,024	63,717	297	465,867
1890 ..	24,141	130,837	26,470	29,114	195,078	60,604	422	476,666
1891 ..	42,458	142,846	63,406	33,554	268,134	64,158	417	614,973
1892 ..	37,184	113,712	39,558	26,554	283,393	58,037	341	558,779
1893 ..	55,565	87,360	37,487	29,714	338,927	70,532	538	620,123
1894 ..	41,993	119,410	43,343	24,318	431,161	93,288	317	752,830
1895 ..	61,808	116,627	45,619	25,824	451,141	128,510	284	820,813
1896 ..	49,529	129,413	52,163	24,750	438,348	135,472	135	829,510
1897 ..	39,792	113,473	31,189	29,331	416,060	138,057	274	768,176
1898 ..	34,964	123,839	30,803	31,724	468,403	157,639	165	847,534
1899 ..	23,438	109,813	30,383	40,703	415,098	157,633	113	777,181
1900 ..	33,267	155,656	39,492	46,875	388,174	174,658	238	838,360
1901 ..	201,716	180,978	42,710	49,257	671,960	263,755	158	1,410,534
1902 ..	636,716	366,815	48,960	47,491	743,453	283,507	150	2,126,803
1903 ..	638,182	378,611	73,099	48,305	768,484	293,046	177	2,199,984
1904 ..	395,990	210,049	68,364	44,679	800,000	256,186	147	2,770,886
1905 ..	472,504	284,755	147,217	51,877	820,000	281,351	135	3,349,880
1906 ..	365,026	369,408	163,578	62,923	802,290	267,550	142	3,666,274
1907 ..	227,333	417,694	206,910	74,788	833,180	268,992	[375	3,455,890
1908 ..	475,267	331,323	121,993	77,864	878,774	314,618	271	3,735,916
1909 ..	474,853	364,662	121,742	66,300	906,782	326,403	289	4,043,730
1910 ..	404,400	515,722	162,990	70,490	1,050,592	345,451	389	4,868,522
1911 ..	651,415	520,120	123,931	86,344	1,189,205	409,682	367	5,389,904
1912 ..	695,240	523,026	191,423	110,921	1,336,755	422,041	658	6,020,902
1913 ..	700,779	500,538	134,293	113,418	1,619,400	663,644	763	6,497,000
1914 ..	—	—	—	—	—	—	—	—
1915 ..	—	—	—	—	—	—	—	—
1916 ..	—	—	—	—	—	—	—	—
1917 ..	—	—	—	—	—	—	—	—
1918 ..	—	—	—	—	—	—	—	—
1919 ..	—	—	—	—	—	—	—	—
1920 ..	20,185	152,015		36,879	460,277	232,110	—	1,750,601
1921 ..	—	—		—	—	—	—	—
1922 ..	102,115	342,292		52,064	512,313	253,754	15,966	2,654,207
1923* ..	62,076	50,024		18,049	197,432	173,378	13,298	1,328,082
1924* ..	46,507	88,134		21,523	242,906	219,657	3,446	1,955,110

* Germany only. after May, 1922.

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FOUNDRY FOREMAN, disengaged, desires position; experienced all branches of engineering and jobbing work, iron and non-ferrous, up-to-date on cupola and mixing of metals by analysis; McLain graduate; good organiser.—Box 424, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

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MACHINERY.—*Continued.*

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